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VOL. 36. Ser. A. Part 3. pp. 73-104. MARCH, 1948.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

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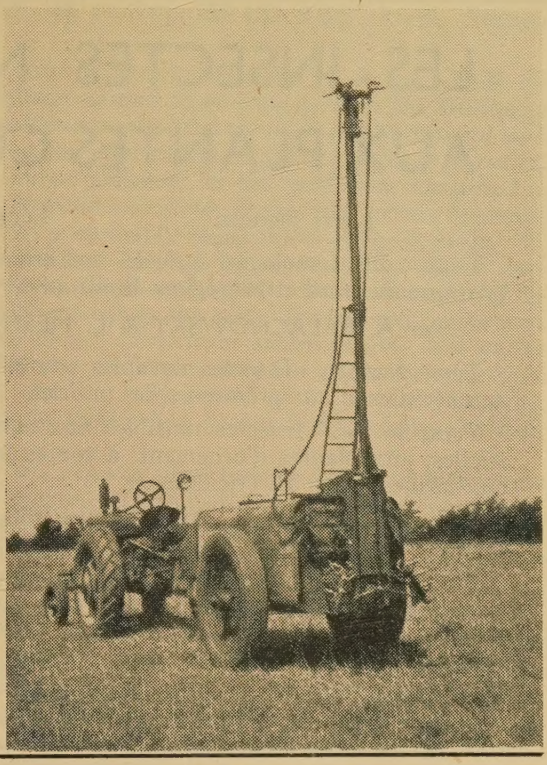

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Insect Pests.—*Agric. Gaz. N.S.W.* **58** pt. 3 pp. 155–158, 3 figs., 2 refs. Sydney, 1947.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **36** 46] includes notes on the severe damage caused to growing peas in the Millthorpe district in 1946 by weevil larvae that attacked the stems at or near ground level so that many of the plants wilted and died and some did not develop above the ground. Adults reared from pupae collected in the field were identified as *Prosayleus dispar*, Germ., and *Desiantha caudata*, Pasc. ; the former appeared to be the more numerous and had presumably caused most of the damage. In late October, when the injury was first noticed, larvae and a few pupae were found in the soil beneath the injured plants, and by 12th November most of the larvae had pupated in small earthen cells in the soil. Larvae and pupae were also abundant in subterranean clover [*Trifolium subterraneum*] and native grass sward, and near the headlands. *P. dispar* does not appear to have been observed previously as a pest, and the only record of *D. caudata* damaging plants in New South Wales was in 1899, when it attacked the foliage of fruit trees [*cf.* **15** 216].

Tunnelling of the stalks and leaf veins of silver beet by larvae of *Haplomyza imitans*, Mall., has occurred in several districts in New South Wales since 1930, when it was first discovered there ; severe infestation causes the plants to wither and die. This Agromyzid was described in 1934 from specimens obtained in Sydney, where the larvae were found mining spinach, wallflower and *Stellaria media* in October 1931. It is possible that it could be controlled by the treatment with nicotine sulphate in oil emulsion recommended against *Agromyza phaseoli*, Coq., on beans [*cf.* **28** 564, etc.] or by DDT sprays, which are effective against the latter [*cf.* **36** 46–47], but the use of DDT on silver beet, except in the earlier stages of growth, is not recommended, owing to the risk of residues on the leaves and stalks. As *H. imitans* is injurious only in certain seasons, routine control measures are hardly necessary.

WALLACE (C. R.). **Control of Black Beetle in Lawns.**—*Agric. Gaz. N.S.W.* **58** pt. 3 p. 158. Sydney, 1947.

In coastal districts of New South Wales, much damage is caused to lawns and golf greens by adults of the Dynastid, *Heteronychus sanctae-helenae*, Blanch., which burrow in the soil and raise small mounds, causing marked irregularities in the turf. In recent experiments against them, various preparations of DDT and 666 [benzene hexachloride] were mixed with water and sprinkled over the turf with a watering can. Two of the best treatments (both at the rate of 1 gal. per sq. yard) were a suspension containing 0·08 per cent. p,p′ DDT, prepared from a proprietary paste, and an emulsified solution containing 0·13 per cent. p,p′ DDT prepared by diluting a stock solution of 16·7 per cent. p,p′ DDT and emulsifier in solvent naphtha. Each of these treatments, when applied towards evening, caused the beetles to come to the surface and show symptoms of extreme poisoning. The beetles can be removed the next morning by mowing the turf with a lawn mower fitted with the usual grass-box.

Danger of harmful D.D.T. Residue on Vegetable Crops.—*Agric. Gaz. N.S.W.* **58** pt. 3 p. 166. Sydney, 1947.

A warning is issued by New South Wales Departments of Health and Agriculture concerning the risk to consumers of lack of precautions in the use of DDT by vegetable growers. While DDT is not so dangerous as arsenic, it is toxic to man and animals, and, as it is regarded as an extremely cumulative poison, its indiscriminate use may expose consumers to the continuous ingestion of amounts that may eventually have injurious effects. Vegetable growers are warned that there should be an interval of a month between the last application of DDT and the marketing of the product.

(179) Wt. P5/3779 3/48 S.E.R. Ltd. Gp. 432 [A]

JENKINS (C. F. H.) & FORTE (P. N.). **1945–1946 Experiments with D.D.T. and 666 as agricultural Insecticides.**—*J. Dep. Agric. W. Aust.* (2) **23** no. 4 pp. 307–317, 5 figs., 12 refs. Perth, W.A., 1946.

In experiments in Western Australia, a dust of 1 per cent. DDT in pyrophyllite and a spray containing 0·1 per cent. DDT as an emulsified solution both gave good control of *Plutella maculipennis*, Curt., on cauliflower, the cabbage butterfly, *Pieris rapae*, L., and *Plusia* (*Phytometra*) *argentifera*, Gn., on potato, lettuce, silver beet and cabbage, but neither was of value against *Nysius vinitor*, Bergr., on potatoes or the cabbage Aphid, *Brevicoryne brassicae*, L. The dust was effective against *Heliothis armigera*, Hb., on flax and *Halotydeus destructor*, Tucker, on seedling flax and young garden peas, and the spray against *Toxoptera aurantii*, Boy., on orange and *Typhlocyba froggatti*, Baker, on apple, but *Bryobia praetiosa*, Koch, increased rapidly on the treated apple trees. The spray failed to control *Ceroplastes destructor*, Newst., *Saissetia oleae*, Bern., and *Aonidiella aurantii*, Mask., on *Citrus*, but DDT was highly effective against *Iridomyrmex humilis*, Mayr, on *Citrus* trees carrying a heavy scale and ant population. Spraying the trunks and lower limbs to a height of 3½ ft. with the emulsion at concentrations of 0·1, 0·5 and 1 per cent. DDT freed the trees from ants and kept them free for three, five and seven weeks, respectively, while the highest concentration kept the numbers of ants at a low level for a further 14 weeks. Banding the trunks with 12-inch strips of hessian saturated with emulsion containing 20 per cent. DDT kept off the ants provided that the bands were everywhere in contact with the trunk, but a water paste containing 3 or 5 per cent. DDT on pyrophyllite painted in bands round the trunks was ineffective. Tomatos, potatoes and melons treated with DDT were kept almost free from infestation by *Empoasca terrae-reginae*, Paoli, and a bait of bran and molasses containing DDT was about as effective against *Austroicetes cruciata*, Sauss., as a sodium-arsenite bait. In a test to determine whether harmful residues persist on vegetables treated with DDT, the amount in raw and cooked samples of cabbage was found to be less than 7 parts per million, which was the lowest limit that could be determined on the quantity of material available, when the outer leaves were removed, and 40 and less than 7 p.p.m., respectively, when they were not.

Benzene hexachloride in a dust was ineffective against *Plutella maculipennis*, *Pieris rapae* and *B. brassicae* on crucifers, *E. terrae-reginae* on tomato and *N. vinitor* on potato. In sprays it was ineffective against *N. vinitor* and against *T. froggatti* on apple, and *Ceroplastes destructor*, *S. oleae* and *Aonidiella aurantii* on *Citrus*, but controlled *Plutella maculipennis* and *Pieris rapae*. It was very effective when used in bran baits either with or without molasses against *Austroicetes cruciata*, and acted much more rapidly than DDT or sodium arsenite.

PINHEY (E. C. G.). **The Olive Bug.**—*Rhod. agric. J.* **43** no. 1 pp. 8–10, 3 refs. Salisbury, S. Rhod., 1946.

The Tingid, *Teleonemia australis*, Dist., which was first observed in Southern Rhodesia in 1935, occurs there on cultivated and wild olives, but has not been found on any other plants. The eggs are laid in clusters on the undersides of leaves, and the gregarious nymphs secrete a sticky fluid that clogs the pores of the leaves and causes them to wither and die. Both the nymphs and the adults, which are active and fly readily in sunshine, feed on the sap and weaken the trees [*cf. R.A.E.*, A **12** 38] ; they were observed in all months from May to December in the neighbourhood of Umtali, and breeding probably continues throughout the year. Some of the varieties of olive grown in this district were more severely infested than others ; a few adults of a Mirid predacious on the nymphs were found on all the trees examined.

Of control methods tested, jarring the branches of the trees over a sheet in the early morning [*cf.* **13** 2] dislodged the adults but not the nymphs, bait-sprays containing soluble arsenicals killed many nymphs and adults but damaged the foliage [*cf.* **33** 126], and twigs of *Eucalyptus* dipped in the bait and suspended in the trees did not attract the nymphs from the leaves. Thorough dusting or spraying was difficult, owing to the density of the foliage, but dusts containing pyrethrum, derris or, in very small-scale experiments, DDT, gave good results. Sprays containing various contact insecticides were effective ; the most satisfactory against both nymphs and adults were a 2½ per cent. solution of blue mottled soap or a spray of 1 pint nicotine sulphate containing 7 per cent. nicotine, with or without the addition of 1 pint 10 per cent. soap solution. The 2½ per cent. soap solution at the rate of 1 gal. per 12–14 ft. tree is recommended for control ; it not only reduced the infestation, but also helped to remove the nymphal secretion from the leaves. A few fortnightly applications should be followed by monthly ones until the trees are clean.

Sukhov (K. S.) & Vovk (A. M.). **Transmission of the Mosaic Virus of Tobacco through Larvae of *Plusia gamma* L.**—*C.R. Acad. Sci. URSS* (N.S.) **49** no. 2 pp. 146–147, 3 refs. Moscow, 1945.

Although sucking insects play no part in the transmission of tobacco mosaic [*Marmor tabaci* var. *vulgare* of Holmes] to tobacco [*cf. R.A.E.*, A **23** 346], nothing is known of the possible importance of chewing insects as vectors. In experiments, in Russia, larvae of *Plusia gamma*, L., that had fed on diseased tobacco, were transferred in batches of 3–4 to healthy plants and allowed to feed. Those that were removed as soon as they had begun to feed, so that presumably infected tissue was not consumed, transmitted the virus to 13 per cent. of the plants, and those that fed for several hours to 20 per cent., as compared with a little over 1 per cent. infection in the controls. The excreta of larvae that had fed for a long time on infected tobacco were infective when tested as an extract on healthy leaves of *Nicotiana glutinosa*, but not those of larvae that had subsequently fed for 24 hours on healthy plants. The virus is apparently inactivated in the insect gut, and when larvae from healthy plants were kept without food for seven hours until defaecation was complete and then fed on diseased leaves, an extract of the excreta subsequently collected proved far less infective than one of the original diseased leaves. *Plusia gamma* probably effects little transmission in the field, but other insects, such as *Agrotis* (*Euxoa*) *segetum*, Schiff., which is common on tobacco in the Crimea, may also be involved.

Nolte (H. W.). **Über den Kot von Fichten- und Kieferninsekten.** [On the Excreta of Spruce and Pine Insects.]—*Tharandt. forstl. Jb.* **90** pt. 10 pp. 740–761, 10 figs., 12 refs. Berlin, 1939.

The collection of excreta has frequently been undertaken during recent outbreaks of forest insects in Germany as a supplementary means of assessing the abundance and stage of development of the pest concerned [*cf. R.A.E.*, A **20** 236]. Interpretation of the results is fairly simple when only one species is present, but not when it becomes necessary to distinguish between the excreta of several. This is usually impossible in the case of very young stages, and not always easy with older ones. The author describes the normal form of the excreta of various insects that commonly occur in Germany on spruce, pine, or both, and gives a key to enable workers to identify the excreta of single species or groups of species. The single species are *Bupalus* (*Geometra*) *piniarius*, L., *Sphinx pinastri*, L., *Panolis flammea*, Schiff., and *Dendrolimus pini*, L., all on pine, *Pristiphora abietina*, Christ (*Lygaeonematus pini*, Retz.) and *Gilpinia* (*Lophyrus*) *polytoma*, Htg., both on spruce, and *Selenephera lunigera*, Esp.,

Orgyia antiqua, L., *Lymantria monacha*, L., and *Barbitistes constrictus*, Brunn., on pine and spruce. The groups that can be separated from other groups or species but not subdivided are *Diprion* (*Lophyrus*) *pini*, L., *Neodiprion sertifer*, Geoffr. (*L. rufus*, Retz.) and *G.* (*L.*) *pallida*, Klug, on pine; *Eilema* (*Lithosia*) *deplana*, Esp., and *Oeonistis quadra*, L., on pine and spruce; and the pine sawfly, *Acantholyda pinivora*, Ensl. (*Lyda stellata*, Christ) and *Cephaleia* (*Lyda*) *abietis*, L., on spruce.

The excreta do not always appear in their typical form, however, and identification is then not easy. Variations are caused by feeding on different food-plants, *Lymantria monacha* being adduced as an example, by changes in temperature and humidity, and by the presence on the leaves of poisons, whether as insecticides or (in industrial areas) residues from furnace gases.

The excreta can be collected by means of sheets of cloth stretched beneath the trees, large wooden funnels through which the excreta fall into a container beneath, or sheets of sticky paper placed beneath any desired portion of the crown. The last method can be used in wet weather and only a portion of each sheet need be sampled. The operator should note the species of tree concerned, the species of insects feeding at the time and the stages of development reached by each. A table is given showing the feeding periods of the insects included in the key, with notes on relevant habits.

DE TOLEDO (A. A.). **Contrôle do caruncho do feijão com substâncias graxas.** [Control of *Bruchus obtectus* with greasy Substances.]—*Biológico* **12** no. 6 pp. 149–156, 1 fig. São Paulo, 1946.

Stored beans in Brazil are seriously injured by *Bruchus obtectus*, Say (*Acanthoscelides obsoletus*, auct.); infestation begins in the field, but most of the damage is done after the beans are harvested. The females lay up to 200 eggs in 3–4 days, and there were up to eight generations a year. Fumigation with carbon bisulphide controls the Bruchid, but does not prevent re-infestation, is expensive and is not practicable for use by small growers. An easy method of preventing infestation is to coat the beans with grease. Of the various materials tested, vegetable oils were not satisfactory, but animal fats gave good results, those with a melting-point of 36–40°C. [96·8–104°F.] being the best. Lard proved outstanding, and in a test in which apparently undamaged beans that had been fumigated with carbon bisulphide to eliminate any latent infestation were shaken up with melted lard at rates of 1, 2 and 4 fl. oz. per 125 lb. until thoroughly coated and then exposed in insect-proof containers to large numbers of Bruchids for six months, the percentages of beans that were damaged were 9, 0 and 0, respectively, as compared with 54 in the controls. There were a few living adults in the beans treated at the lowest rate and none in the other treated lots, but very many in the controls, together with other stages. The lard does not prevent oviposition or hatching, but immobilises the newly-hatched larvae and prevents them from entering the beans. Beans that are already infested should first be fumigated, but treatment with lard alone should suffice for newly-harvested beans, since they usually contain few Bruchids.

SAUER (H. F. G.). **A cigarrinha *Agallia albidula* Uhl. (Hom., Cicadel.) vetora de uma doença de virus do tomateiro.** [*A. albidula*, the Vector of a Virus Disease of Tomato.]—*Biológico* **12** no. 6 pp. 176–178, 2 pls. São Paulo, 1946.

In 1942, investigations on the control of *Leucinodes elegantalis*, Gn., on tomato in São Paulo [*cf. R.A.E.*, A **33** 94] were hampered by the excessive incidence among the plants of virus diseases, particularly spotted wilt [*Lethum australiense* var. *typicum* of Holmes], which is transmitted by a species of *Frankliniella* [*cf.* **29** 141]. In 1945, various insecticides were tested against the

thrips, but although its numbers were noticeably diminished by some of them, disease continued in evidence, and it became clear that another vector and another virus were also involved, since some of the plants displayed symptoms that differed from those characteristic of spotted wilt. Previous investigations on the insects that infest tomato in the area had indicated that *Agallia albidula*, Uhl., was one of the commonest, and it was found in abundance on tomato and also on cotton, potato, lettuce, chicory, beet and pimento (*Capsicum*). In a preliminary test in 1946, in which examples of this Jassid collected in the field were fed first on diseased and then on healthy tomato plants, the unidentified virus was transmitted to one-third of the healthy plants when five or ten Jassids were placed on each, and to one-half or two-thirds when 50 Jassids were employed. The symptoms, which are described in detail, appeared after about four weeks and varied somewhat according to the number of Jassids. In general, seedlings infested by 50 in the laboratory ceased to develop ; their leaves became deformed and reddish in colour, with violet veins and patches of light green and yellow on the upper surface. A few weeks later, growth began again, but the shoots were deformed and the flowers and fruits were small. Older plants and those less heavily infested showed less severe symptoms.

WISHART (G.). **Laboratory Rearing of *Macrocentrus gifuensis* Ashm., a Parasite of the European Corn Borer.**—*Canad. Ent.* **78** no. 4 pp. 78–82, 2 graphs, 6 refs. Guelph, Ont., 1946.

Macrocentrus gifuensis, Ashm., a polyembryonic Braconid parasite of *Pyrausta nubilalis*, Hb. [*cf. R.A.E.*, A **19** 436–438], was introduced into Canada from Europe in 1928 [**18** 118] and subsequently from Korea and Japan. The European strain was liberated in Nova Scotia, Quebec and Ontario in 1928–32, but was recovered only at Chatham, Ontario. The oriental strain was released in Quebec, Ontario and New Brunswick and was far more successful [*cf.* also **31** 288], being recovered consistently wherever it had been liberated under favourable conditions. In nature, the parasite hibernates as an egg in the diapause host, and though the two strains show no morphological differences, the author found that the European strain requires a period in diapause before it will complete its development in the one-generation strain of *P. nubilalis*, while at the same temperatures (75–80°F.), the oriental strain does not.

The technique employed by the author for rearing the parasite in the laboratory is described. Host larvae are produced in a manner essentially the same as that described by Briand [**17** 394], except that they are fed almost exclusively on green string beans. Both sexes of *M. gifuensis* pair shortly after emergence, sometimes more than once, but females that have paired only once yield progeny with the most satisfactory sex ratio. Females are ready to oviposit 3–4 days after emergence when kept at 75°F. in the daytime and 60°F. at night. When numbers of females are kept together to obtain parasites for liberation, a wooden cage about 7 ins. square and slightly less deep, the back of fine cheese cloth and the sliding front of clear xylonite, is used, but a smaller one is sufficient for smaller lots or for individual females. The cage is placed with the back to the light, and a host larva, preferably of the third or fourth instar, is introduced through the front by means of a camel's-hair brush and removed in the same way after having been stung. It is sometimes impossible to remove the host before it has been stung repeatedly, and this may possibly be advantageous to ensure that an egg has been laid in it, but the deposition of more than one egg in a host has no significant effect on the size of the subsequent brood. Thus, the average numbers of parasites per host obtained from hosts parasitised once, twice and five times by virgin females were 25·5, 25·3 and 26·1, respectively. The parasitised larva is placed in a two-inch vial with green beans, which are changed every 3–4 days. When the larva ceases to feed, a piece of folded blotting-paper is placed in the vial to keep the emerging parasite larvae together, since, unless

they are crowded as in maize stalks in nature, they do not spin a cocoon mass and many of them remain naked and die without completing their development. The time required for development from egg to cocoon mass varies considerably, probably because larvae of the single generation strain of *Pyrausta* are used as hosts ; when kept at 80°F., some of these larvae enter diapause and others pupate without doing so. Since host larvae fed entirely on beans do not hibernate well and contain much less fat than those that feed on maize in nature, parasitised larvae intended for hibernation are given pieces of maize stalk in three-inch vials for the latter part of their feeding period. They are kept at about 75°F. by day and at 60°F. at night to ensure the diapause.

The parasite larvae completed the formation of the cocoon mass two hours after they left the host, and, at 80–82°F., the adults emerged 8–12 days later. All adults from the same mass emerged within 15 minutes. The author considers that this concerted emergence is the result of a movement stimulus, since where cocoon masses were divided, emergence from the two parts was not simultaneous, and also, when both sexes are present in the same mass they emerged at the same time, despite the normal tendency of males to emerge earlier than females. A wide variation in the number of adults emerging from one cocoon mass was observed ; the average numbers of males and females per mass from masses that yielded one sex only were 17·65, respectively, which does not support Flanders' statement that pure male broods are smaller than pure female broods in species in which both sexes develop polyembryonically [**30** 531]. Only 10·5 per cent. of the masses yielded both sexes, and 71·6 per cent. of these yielded more females than males. In 80 cocoon masses collected from the field where liberation had been made, the average numbers of males and females per mass were 20·9 and 17·9, respectively, and 7·7 per cent. of the masses yielded both sexes.

WILKES (A.). **The Introduction of Insect Parasites of the Spruce Budworm, *Archips fumiferana* Clem., into eastern Canada.**—*Canad. Ent.* **78** no. 4 pp. 82–86, 2 refs. Guelph, Ont., 1946.

In view of the extent and intensity of infestation [of *Abies balsamea* and spruce] by *Harmologa* (*Archips*) *fumiferana*, Clem., in eastern Canada [*cf. R.A.E.*, A **33** 143 ; **35** 99] attempts to introduce parasites known to attack it in British Columbia, notably the Ichneumonid, *Phytodietus fumiferanae*, Rohw. [*cf.* **11** 446], were begun in 1943. The work was extended in 1944 and 1945 and 45 species of parasites were obtained at the Belleville Laboratory in Ontario from the material collected in British Columbia. The most numerous of these were *P. fumiferanae*, and the Tachinids, *Ceromasia auricaudata*, Tns., and *Phorocera incrassata*, Smith, none of which had been found in eastern Canada, and a Sarcophagid, *Agria* (*Pseudosarcophaga*) *affinis*, Fall. Over 10,000 adults of these parasites were liberated ; they comprised 499 of *Phytodietus*, 2,184 of *Ceromasia* and 122 of *Phorocera* in Ontario and 2,600 of *Phytodietus*, 4,649 of *Ceromasia* and 450 of *Agria* in Quebec.

The method used in obtaining the parasites was modified from time to time, but in general the larvae and pupae of *Harmologa* and free parasites were collected by hand from the trees ; the larvae were reared to the pupal stage, and the pupae, together with those collected from the field, were despatched in ordinary mailing tubes containing fine sawdust. Reared cocoons of *Phytodietus* were despatched in small cardboard boxes.

Phytodietus fumiferanae has one generation a year, the mature larvae overwintering in cocoons on the trees. Some pupate in the following spring, but rearing records indicate that 20–40 per cent. remain in diapause for another year or more. To rear this Ichneumonid in the laboratory, adults obtained from the cocoons in early spring are allowed to pair, and the females are confined singly in cloth-covered cages measuring 4×4×3 ins. They are ready to

oviposit after 15 days, and three or four mature larvae of *Harmologa* are then placed in each cage. When eggs have been laid on them, they are removed and kept in three-inch shell vials with spruce foliage, which is changed every 24 hours. At a rearing temperature of 75°F. the parasite larvae soon hatch, feed on the body fluids of their hosts for 11 days, and then leave them and construct their cocoons. Shortly after they are formed, the cocoons are stored in cardboard boxes at 32–34°F. The adults emerge eight months later when incubated for 15–20 days at 74°F. Propagation of this species was carried out on an experimental basis from 1944 onwards, and large-scale production in the laboratory was planned for 1947.

DANIELS (L. B.). **The Peach Mosaic Disease.**—*Science* **101** no. 2613 pp. 87–88. Lancaster, Pa., 1945.

Field experiments in Colorado in 1942 and 1943 produced evidence, subsequently confirmed in greenhouse tests in 1943 and 1944, that *Myzus persicae*, Sulz., can transmit the virus of peach mosaic disease [*Marmor persicae* of Holmes]. The Aphids used for the greenhouse experiments were apterous and alate viviparae from cultures of *M. persicae* maintained throughout the year on potato plants. They were allowed to feed for various periods on the flowers and foliage of diseased peach twigs, and the flowers and leaves were then removed from the twigs and suspended in the tops of 25 peach seedlings under insect-proof cages in the greenhouse. These seedlings were grown from Georgia seed, such seedlings having never shown symptoms of the disease except when inoculated vegetatively. When the Aphids had migrated to the seedlings, they were confined on them for various periods in closed glass chambers. Symptoms appeared in 18 of the seedlings, and the controls remained healthy. Since the symptoms were mild, bark from the infected seedlings was grafted on to healthy ones and June-budded Elberta trees and typical symptoms developed as a result of these grafts. Transmission experiments were also made with other insects that are more or less common in peach orchards in Colorado, but none was successful.

ARMITAGE (H. M.) & STEINWEDEN (J. B.). **Tolerance of Citrus Fruits to Methyl Bromide as a Fumigant.**—*Bull. Dep. Agric. Calif.* **35** no. 1 pp. 21–29, 2 figs. Sacramento, Calif., 1946.

Limes from Mexico must be treated to free them from surface pests, including *Selenaspidus articulatus*, Morg., *Parlatoria pergandei*, Comst., *Chrysomphalus ficus*, Ashm., *C. dictyospermi*, Morg., and *Lepidosaphes gloveri*, Pack.. as a condition of entry into California. As most of the fruits arrive under refrigeration, they sweat at fumigation temperatures, and so are injured by hydrocyanic acid gas, but submergence of the boxes containing them for at least three minutes in an emulsion containing 3 per cent. oil with a viscosity of 70 Saybolt and an unsulphonatable residue of 90 gave satisfactory control with minimum injury to the fruit and was the measure adopted. The limes were not always dried after treatment, however, and often reached the retailers in an unsatisfactory condition. Moreover, the authorities in Arizona requested treatment of *Citrus* fruits from California to prevent the introduction of *Aonidiella aurantii*, Mask., and the fumigation of *Citrus* fruits was therefore further investigated.

Hydrocyanic acid gas has been used for several years to free *Citrus* fruits exported to Hawaii in winter from *Hercothrips fasciatus*, Perg., but the relatively low concentrations employed were known to be ineffective against *A. aurantii*, and higher ones are injurious. Methyl bromide is used to control *A. aurantii* on nursery stock and did not injure oranges in a small-scale test in 1936, and experiments were therefore carried out with it during the winter of 1944–45. In all of these, the period of exposure was two hours. Mortality of *A. aurantii*

was complete on navel oranges exposed to a dosage of 2½ lb. per 1,000 cu. ft. at 80°F. and a relative humidity of 54 per cent. and on limes exposed to 2¼, 2½ and 3 lb. at 74–78, 81–83 and 72–74°F. and 75 per cent. humidity, and not quite complete on oranges or limes exposed to 2 lb. at or about 80°F. In small-scale tests of its effect on *Citrus* fruits, lemons and limes were not damaged by methyl bromide at any of the rates employed. Grapefruits were not injured by the minimum dosages required to give complete mortality of *A. aurantii*, but were marked and discoloured by higher ones; Washington navel oranges were marked and discoloured by all dosages. The injury sometimes did not appear until two weeks after treatment, but it then developed steadily. It comprised the gradual breaking down of oil cells and intercellular tissues, resulting in a deep pitting represented in both small and relatively large brown areas.

The effect of one hour's exposure to hydrocyanic acid gas at dosages of 15, 20 and 25 cc. was tested on limes at 79°F. and 44 or 42 per cent. humidity. Those treated immediately after refrigeration were injured by all dosages, but those not refrigerated showed no injury, except for one fruit out of 13 exposed to the highest dosage. All dosages gave complete mortality of *A. aurantii* on limes, but the number of scales was too small for this result to be significant. However, no damage to fruit and no living example of *A. aurantii* were found over a period of 16 months during official inspection of 546 limes fumigated for one hour with hydrocyanic acid gas generated from sodium cyanide and sulphuric acid at a rate equivalent to 25 cc. per 100 cu. ft.

BASINGER (A. J.) & SMITH (H. S.). **Notes on the Time of Emergence, Longevity, and Oviposition of Codling Moth from Walnuts, Apples and Pears.**—*Bull. Dep. Agric. Calif.* **35** no. 1 pp. 37–38, 1 ref. Sacramento, Calif., 1946.

The fact that the codling moth [*Cydia pomonella*, L.] became an important pest of Persian walnut [*Juglans regia*] in California long after it had been common there on apples suggested that a new biological race was being evolved [*R.A.E.*, A **24** 158], but studies by H. J. Quayle showed that the larvae could develop equally well in either walnut or apple, regardless of their origin. As a prolongation of the winter diapause or of the life of the females in spring would help to synchronise the development of a walnut race with that of its food-plant [**29** 548], the possible occurrence of such prolongation was investigated in 1940–41. Larvae collected in the autumn of 1940 from walnut and apple in three localities in the southern part of California and from walnut, apple and pear at Stockton, over 300 miles to the north of them, were allowed to overwinter in a lath house shielded from direct sunlight, and the adults to which the cocoons gave rise in spring were kept singly or in pairs in glass jars and given sugar solution as food. Adults from all localities emerged during March–June, but 85 per cent. of the Stockton moths had emerged when only 15, 30 and 45 per cent. of those from the three southern districts had done so. Moreover, 80 per cent. of the apple moths from Stockton had emerged when only 50 per cent. of the walnut moths had done so, whereas the walnut moths from two of the southern districts emerged at about the same time as the apple moths and those from the third emerged earlier. The moths from the different food-plants showed no significant differences in lateness of survival, duration of life or number of eggs laid.

KEIFER (H. H.). **Eriophyid Studies XVI.**—*Bull. Dep. Agric. Calif.* **35** no. 1 pp. 39–44, 4 pls. Sacramento, Calif., 1946.

The new species described in this part of a series [*cf. R.A.E.*, A **35** 325] include *Vasates malivagrans*, found on the lower surface of apple leaves in California, and said to cause pitting of the young leaves [*cf.* **36** 82], and *Oxypleurites mangiferae* which produces rust on the undersides of the leaves of mango in Hawaii and is said to be easily controlled by sulphur applications.

DECKER (G. C.). **Agricultural Applications of DDT, with special Reference to the Importance of Residues.**—*J. econ. Ent.* **39** no. 5 pp. 557–562. Menasha, Wis., 1946.

The author discusses the possible injurious effects on man or domestic animals of DDT residues on plants, with special reference to the United States. He points out that there is little or no risk in using DDT on plants of which no part is used as food or fodder, on such crops as potato, of which the treated parts are not consumed, or, early in the season, on plants, such as cabbage, grape vines or peas, that produce extensive vegetative growth that has to be protected from insects before the fruits or edible portions appear. The grain of most cereal crops is protected by a covering and unlikely to be dangerously contaminated with DDT, but crop residues that are to be salvaged for fodder should be considered as forage crops. On maize, the treatment applied in the United States against the first generation of the corn borer [*Pyrausta nubilalis*, Hb.] will usually be completed before the ears are produced, and residues would be subject to a considerable period of weathering before harvest. The use of DDT on forage crops should not be encouraged until more is known about the risk involved, but it seems likely that sweet clover [*Melilotus*] can be protected from the sweet clover weevil [*Sitona cylindricollis*, Fhs.] by light applications of a DDT dust soon after the seedlings appear, and that damage by leafhoppers to the second and third cuttings of lucerne can be greatly reduced by light applications of a DDT spray or dust as soon as the previous crop has been removed and before the plants make any appreciable new growth, the residue problem being practically non-existent in both cases. Apple growers will apparently have little difficulty in developing spray schedules incorporating DDT for the control of at least the first generation of the codling moth [*Cydia pomonella*, L.] without exceeding the tolerance [*cf.* *R.A.E.*, A **35** 110].

Little is known of the quantity of DDT to be expected on vegetable and fodder crops or of its danger to warm-blooded animals. Preliminary studies on apples indicate that dosages of up to 1 lb. DDT per 100 U.S. gals. become ineffective after 2–4 weeks through loss or decomposition, and the available data suggest that the time between the last application and harvest has a much greater influence on the ultimate DDT residue than the number of applications or the amount of DDT applied. In heavy DDT spray schedules, the addition of a summer oil or adhesive will almost certainly produce residues in excess of the tolerance, but if adhesives are omitted and the trees are not sprayed within 4–6 weeks of harvest, several sprays of 1 lb. DDT per 100 U.S. gals. can be applied without producing an excessive residue [*cf.* **35** 320]. Similar results were obtained in experiments by T. C. Watkins, in which lettuces dusted with 3 per cent. DDT, 1, 2, 3, 4 and 5 times at weekly intervals beginning on 14th August and harvested on 14th September, two days after the fifth treatment, had 0·2, 0·2, 4, 20 and 211 parts DDT per million on the trimmed heads and 4, 12, 110, 185 and 358 p.p.m. on the trimmings, whereas if the residues were determined by the total amount of DDT applied, they should have been approximately in arithmetic progression. Residue analysis on stems and leaves, husks and silks, and kernels of maize treated with DDT for the control of *P. nubilalis* showed 0·32, 0·006 and 0·008 p.p.m., respectively, on plants sprayed four times with 0·85–0·95 lb. DDT per acre, 1·88, 0 and 1·59 p.p.m. on plants dusted four times with 2·5 per cent. DDT and 2·1, 0·4 and 0·13 p.p.m. on plants dusted four times with 5 per cent. DDT. Silage made from maize ten days after the last of three applications of 5 per cent. DDT dust at 20 lb. per acre contained 4 parts DDT per million. It thus appears that if a reasonable time elapses between treatment and harvest, DDT can be used on many crops without fear of large residues, and there is little or no evidence that residues from the small amount of DDT required to control insects would in any way endanger human health.

It is agreed that the acute and subacute toxicity of DDT to warm-blooded animals is no greater than that of several insecticides in common use, but there is little information on the effect of small quantities such as may be encountered in crop residues, most published reports dealing with animals given large amounts (50–200 mg. per kg. body weight). Pigs fed for seven months on maize containing 555 parts DDT per million (about 80 times the tolerance on apples and pears) remained normal; their leaf fat, liver tissues and kidney tissue contained 271–387, 1·6–3·6 and 1·2–32 p.p.m. DDT, respectively. Sheep and cattle that fed for several months on silage treated with DDT showed no ill effects, and hens and small chickens fed only on a mash containing 111 p.p.m. DDT for ten weeks remained apparently healthy. In preliminary tests, animals given DDT in quantities approaching the subacute toxic level eliminated the compound in the butter-fat in the milk [*cf.* B **35** 193], but as animals have a mixed diet under practical conditions, and it will be seldom that all of any one component of the diet bears DDT residues, further evidence is needed to show whether animals receiving only normal residues in part of their diet also eliminate dangerous amounts of DDT in their milk.

In many instances, only the uncertainty with regard to residues precludes the use of DDT on agricultural crops, and it is emphasised that it is important to determine as rapidly as possible the deposits of DDT found on plants immediately after treatment at known rates of application, the rate of decomposition or loss of DDT from the plants, the residues retained at harvest in practice, and the possible value of neutralising or decontaminating sprays if such are needed.

KEIFER (H. H.). **A Review of North American economic Eriophyid Mites.**—*J. econ. Ent.* **39** no. 5 pp. 563–570, refs. Menasha, Wis., 1946.

About 50 species of Eriophyid mites are of economic importance in North America, and in this paper the author discusses the bionomics of the group, their natural enemies, which include predacious mites, such as *Seius pomi*, Parrott, thrips [*cf. R.A.E.*, A **29** 210], the larvae of other insects [*cf.* **16** 232] and possibly fungi, and their control by acaricides. It is probable that sulphur, which is the most important of these and may be applied as the pure dust, wettable sulphur or lime-sulphur, is absorbed by the skin in the pure form or as a compound, in somewhat the same manner as oxygen, or with it, and acts by blocking the breathing apparatus. Petroleum-oil sprays and derivatives of dinitro-ortho-cyclohexylphenol in sprays and dusts are effective against certain species against which lime-sulphur cannot be used because of plant injury. The two general types of Eriophyids are the soft-bodied species that live in galls or buds and the harder-bodied rust mites that live on the surface of the leaves. The rust mites that feed on deciduous trees usually develop deutogynes (hibernating females) that probably cannot reproduce during the season in which they are formed.

The individual species concerned are shown in a list arranged under their food-plants, with notes on their distribution in North America and elsewhere, the type of injury caused, and the identity and control of some of them. Of those discussed individually, the pear leaf blister mite, *Eriophyes pyri*, Pgst., is probably the best known, but less is known of a biological form (sometimes called the pear bud mite) that destroys the buds but causes no leaf blisters. The pear rust mite, *Epitrimerus pyri*, Nal., feeds on young leaves in spring and early summer and then produces deutogynes that aestivate but may be able to reproduce in the same year, since the mite reappears on summer flushes of new growth. The relationship between *Eriophyes pyri* and the apple blister mite, for which the name *E. pyri mali*, Nal., is used, is not yet known. Apple is also

attacked by a bud mite that is apparently distinct from the latter and by the rust mites, *Vasates* (*Phyllocoptes*) *schlechtendali*, Nal., and *Calepitrimerus baileyi*, Keifer. *V. cornutus*, Banks, which is generally distributed on peach, and *V.* (*Phyllocoptes*) *fockeui*, Nal. & Trt., which occurs on plum in the northern United States and Canada, are morphologically very similar but are apparently distinct, since plum trees growing close to peach in California are not infested though the peaches are. Other species discussed are *Phyllocoptruta oleivorus*, Ashm., and *Aceria sheldoni*, Ewing, on *Citrus*, *Eriophyes vitis*, Pgst., and *C.* (*Epitrimerus*) *vitis*, Nal., on grape vines, *A.* (*Eriophyes*) *essigi*, Hassan, on blackberry fruits along the Pacific Coast, the big-bud mites, *Phytoptus avellanae*, Nal., and *Cecidophyes* (*E.*) *ribis*, Nal., on filberts [*Corylus*] and currants, respectively, and *A. tulipae*, Keifer, which lives between the bulb layers of Liliaceous bulbs such as onion, garlic and tulip, causing them to shrink and dry, and persists in storage. The only one of these mites that does not appear to have been definitely recorded from the United States is *C. ribis*, which occurs in British Columbia [**16** 158].

Vasates malivagrans, Keifer [**36** 80] is considered a synonym of *V. schlechtendali*, *Epitrimerus pirifoliae*, Keifer [**27** 33] of *E. pyri*, and *Diptilomiopus prunorum*, Keifer [*cf.* **27** 288] of *D.* (*E.*) *gigantorhynchus*, Nal., which is common on blackberry in parts of California and is generally distributed on plum, on which it has been recorded in Ontario [**29** 306].

Osburn (M. R.) & Mathis (W.). **Effect of Cultivation on Florida Red Scale Populations.**—*J. econ. Ent.* **39** no. 5 pp. 571–574, 1 fig., 5 refs. Menasha, Wis., 1946.

Investigations in Florida in 1942–44 confirmed an observation made in 1941 that *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) becomes more numerous on cultivated orange trees than on uncultivated ones in the same grove. Cultivation, by disking and hand hoeing, was carried out five times between March and September in 1942 and between January and August in 1943 and four times between February and August in 1944, no one plot being cultivated in two successive years. Counts of living females on the lower surfaces of outer leaves showed that populations were higher on cultivated than on uncultivated trees from July to December in 1942, and from June to October in 1943 and 1944, the greatest differences occurring in October, July and September, respectively. There was very little difference between treatments in the proportion of scales that were parasitised by *Aspidiotiphagus lounsburyi*, Berl. & Paoli, or attacked by the fungus, *Nectria diploa*, on any date. The slight differences in parasitism might be associated with variations in the populations of living scales, but this was not true of the percentages of Coccids affected by fungus.

Disk cultivation slightly increased the deposit of soil or dust on the leaves [*cf. R.A.E.*, A **27** 257], but cultivated trees were more vigorous and in better physical condition than those left uncultivated, even though they were more heavily infested, and it is concluded that tree stimulation as a result of cultivation was the most important factor in the development of the infestations.

Satterthwait (A. F.) & Swain (R. B.). **The Sunflower Moth and some of its natural Enemies.**—*J. econ. Ent.* **39** no. 5 pp. 575–580, 2 refs. Menasha, Wis., 1946.

Sunflower (*Helianthus annuus*) is grown as an oil crop in the United States and also in Cuba, where 73,000 acres were planted in 1932. By September of that year, about 500 acres in the Provinces of Havana and Matanzas had been destroyed by *Homoeosoma electellum*, Hulst. Since the only parasites of this Pyralid in Cuba, *Apanteles homoeosomae*, Mues., and *Nemorilla floralis*, Fall.,

were ineffective, investigations on its bionomics and on its natural enemies in the United States were made with a view to the introduction of a suitable parasite into Cuba. All stages are briefly described.

It was found that *Homoeosoma* was destructive to the sunflower crop in the Mississippi Valley from Louisiana to Missouri and Illinois. Its earliest food-plant in Missouri was *Coreopsis grandiflora*, followed by *Heliopsis helianthoides* var. *pitcheriana*, sunflower, Jerusalem artichoke (*Helianthus tuberosus*), a hybrid *Helianthus* and *Verbesina encelioides*. It was reported from Cuba that the most important wild food-plant was *Bidens pilosa*, but that this was not heavily infested. *Tagetes erecta*, *T. patula*, *Coreopsis tinctoria*, *C. coronata*, *C. lanceolata*, *Rudbeckia fulgida*, *Anthemis tinctoria kelwayi* and *Helianthus* have been recorded as food-plants in Iowa [*cf. R.A.E.*, A **16** 458].

The female deposits its eggs singly or in small groups among or within the florets of sunflower, most of them on one day; as many as 91 have been obtained from a single female. The larvae hatch in 40–72 hours and pass through five instars, which lasted about 4, 3–5, 5, 1–3 and 10–12 days, respectively. They feed chiefly on the florets during the early instars and on the achenes as the latter develop, and were found tunnelling in the receptacle and occupying the hollow stalk beneath it in *Heliopsis*. Infestation is often heavy enough to destroy all the seed in a single flower head, especially where it is the only one on the plant. The full-fed larvae migrate to find suitable places for pupation, usually on the achenes or within one. Adults were observed in the field in Missouri from 28th June to 4th September. Many larvae were taken on 17th June, and it is assumed that the winter is passed in the larval or pupal stage and that there may be four complete generations in the year near St. Louis. In Cuba infestation was heavy in September 1932, and light in June 1933. The life-cycle lasted 24–26 days in September, and the development of the larvae slowed down in winter. Activity practically ceased in December, in spite of the mild climate.

In the course of a survey made in Missouri, Illinois and Louisiana between April and mid-September 1933, a predacious Clerid, *Hydnocera pubescens*, Lec., was found feeding on larvae and pupae of *Homoeosoma* and on an immature larva of the sunflower budworm, *Suleima helianthana*, Ril., the fungus, *Metarrhizium anisopliae*, was found on a larva of *Homoeosoma*, and twelve parasites, notes on the bionomics of which are given, were reared. These comprised *Lixophaga variabilis*, Coq., which was occasionally reared from larvae of *H. electellum* and frequently from those of *S. helianthana* on sunflower and Jerusalem artichoke; *Anachaetopsis tortricis*, Coq., which was reared in large numbers from larvae of *H. electellum*; *Leskiomima tenera*, Wied., which was reared from several larvae of this species; *Epigrimyia* (*Siphophyto*) *floridensis*, Tns., which is a frequent parasite of *Homoeosoma* and *Suleima* and of *Argyroploce* (*Endothenia*) *hebesana*, Wlk., on *Iris germanica*; *Bracon* (*Microbracon*) *mellitor*, Say, a rather general parasite, which was reared from larvae of *H. electellum* and the sunflower head cutworm, *Stibadium spumosum*, Grote, and from unidentified insects on sunflower; *B.* (*M.*) *nuperus*, Cress., which emerged from heads of *Coreopsis grandiflora* heavily infested by *Homoeosoma* in June 1933; *Chelonus altitudinis*, Vier., which emerged from larvae of *Homoeosoma* and *S. spumosum*; *Apanteles homoeosomae*, which was an active parasite of *Homoeosoma* in sunflowers; *Agathis* (*Bassus*) *buttricki*, Vier., which was recovered frequently from infested sunflowers and reared from both *Homoeosoma* and *Suleima*; *Macrocentrus ancylivorus*, Rohw., and *Cremastus epagoges*, Cushm., both of which attack larvae of these two species; one adult of *Perilampus similis*, Cwfd., almost certainly a secondary parasite, which emerged from a cocoon attached to a sack of sunflower heads infested mainly by *Homoeosoma*; and an undescribed species of *Angitia*, which was reared from nine collections of *Homoeosoma* in 1933 and was sent to Cuba in October 1933. Of the 44 pupae dispatched, 28 gave rise to males and the remainder died.

Richardson (C. H.). **Efficiency of Carbon Tetrachloride, Ethylene Dichloride and certain other Fumigants in shelled Corn.**—*J. econ. Ent.* **39** no. 5 pp. 598–607, 21 refs. Menasha, Wis., 1946.

During 1939–43, large quantities of shelled maize were stored in steel bins in the mid-western United States. These were usually fumigated for the control of insects, and the standard mixture of ethylene dichloride and carbon tetrachloride (3 : 1) generally proved effective at a rate of 5–6 U.S. gals. per 1,000 bushels. Failures with it were occasionally reported, however, even under apparently optimum conditions, and the experiments described in this paper were carried out from September 1941 to January 1945 in an attempt to elucidate them. They were directed primarily to examination of the toxicity of carbon tetrachloride, ethylene dichloride and the standard mixture in shelled maize, but other compounds and mixtures were included.

The following is based on the author's summary. Methods are described by which carbon tetrachloride, ethylene dichloride and the standard mixture were tested against *Calandra* (*Sitophilus*) *oryzae*, L., *Tribolium castaneum*, Duv., and *Oryzaephilus surinamensis*, L., in empty space and in containers holding 5 and 27 lb. dry shelled maize.

In empty space at 86°F. and with 24 hours exposure, ethylene dichloride was about twice as toxic as carbon tetrachloride, and the standard mixture approached ethylene dichloride in toxicity. In dry maize, the intrinsically greater toxicity of ethylene dichloride disappeared owing to sorption by the maize, and the two compounds became similar in toxicity. A mixture of carbon bisulphide and carbon tetrachloride (1 : 4 by volume) was about as toxic as carbon tetrachloride alone to *T. castaneum* in maize. Three-component mixtures of carbon bisulphide, 1,1-dichlor-1-nitroethane and carbon tetrachloride became increasingly toxic to *O. surinamensis* in shelled maize as the proportion of dichlornitroethane was increased, mixtures containing 15–20 per cent. of this compound being among the most toxic fumigants tested. In preliminary tests with *T. castaneum*, β-methallyl chloride [*cf. R.A.E.*, A **34** 341–342] was more effective than carbon bisulphide in these mixtures.

Methyl isopropenyl ketone was highly toxic to *C. oryzae*, but was strongly absorbed by the maize. Carbon tetrachloride was at least as effective in shelled maize as trichlorethylene, propylene dichloride and 1,1,2-trichlorethane. It is a safe fumigant to handle if ordinary precautions are taken, but even short exposures to effective insecticidal dosages may be dangerous without the protection of a gas mask. It was found that effective dosages of this fumigant do not reduce the germination of seed maize, even when it is poured directly on to it, but exposures for longer than one week in tight containers are not recommended, and the seed should be thoroughly aerated after exposure.

It is concluded that in gas-tight structures, a dosage of 2 U.S. gals. carbon tetrachloride per 1,000 bushels for 24 hours or longer at temperatures of 70°F. or higher will control the three species of insects used in this investigation in maize. A somewhat higher dosage (3–4 U.S. gals.) may be required under commercial conditions.

Tenhet (J. N.) & Bare (C. O.). **Redrying of Tobacco and its Effect on Insect Infestation.**—*J. econ. Ent.* **39** no. 5 pp. 607–609, 1 fig. Menasha, Wis., 1946.

Flue-cured (cigarette) tobacco, the most important type produced in the United States, is usually stored for about 30 months before being manufactured, and suffers heavy losses from insect attack during this period. When marketed by the farmer, leaf tobacco usually has a high moisture content and so is subject to moulds, rots and infestation by *Ephestia elutella*, Hb., and *Lasioderma serricorne*, F., which may arise on the farm or in the auction-sales warehouse,

but before being stored, the tobacco is subjected to a process known as redrying, to regulate its moisture content. Tobacco intended for use in the United States is passed through a long chamber, where it is subjected to heat to drive off all moisture, after which live steam is introduced to supply the exact amount of moisture required, usually 10–11·5 per cent. ; it is then cooled, packed into hogsheads and compressed under hydraulic pressure. The duration of the treatment usually ranges from 43 to 80 minutes and the maximum temperature from 195 to 230°F. Tobacco for export is treated for a longer period and at higher temperatures.

To determine the effect of this process on any insects that might be present, all stages of *E. elutella* and *L. serricorne* in cages were inserted into the butts of the bundles of tobacco leaves, where they were most protected, and passed through the drying, steam and cooling chambers of the redrying machine ; the total time taken was 43–57 minutes, the maximum temperature of the drying chamber 195–224°F. and the temperature of the steam when it reached the tobacco about 200°F. or less. Larvae and pupae of both species, which seemed to be the most resistant stages, were similarly passed through the drying chamber only or through the steam and cooling chambers only. In each test with the whole process, complete mortality of all stages of both insects was obtained. Mortality was high when larvae and pupae were passed through the drying chamber only, though a few pupae of each species survived in one replicate, and was variable when they were passed through the steam and cooling chambers only, appreciable survival of at least one stage occurring in each test. Leaf tobacco from which the midrib has been removed (tobacco strips) is usually redried for 9–30 minutes at a maximum temperature of 165°F., and when all stages of both insects were buried in such tobacco and passed through a redrying machine in 9–10 minutes, a single pupa of *L. serricorne* survived in one of eight replicated tests.

It is concluded that redried leaf tobacco can be assumed to be free of infestation when it enters storage. Redried tobacco strips will probably be free from infestation, but it is possible that a few insects may survive in them.

Bare (C. O.), Tenhet (J. N.) & Reed (W. D.). **Effect of the Thermal-vacuum Process on Insects in stored Tobacco.**—*J. econ. Ent.* **39** no. 5 pp. 612–613, 3 refs. Menasha, Wis., 1946.

Flue-cured tobacco in maturation storage [*cf.* preceding abstract] is often infested by *Lasioderma serricorne*, F., and *Ephestia elutella*, Hb., which may cause considerable losses, but are less important at this stage than in the finished product. When the tobacco comes out of storage, it is dry and brittle and cannot be handled without loss from breaking and crumbling, and it is therefore moistened, usually by a thermal vacuum process. To determine the effect of this process on insects, cages containing all stages of *L. serricorne* and larvae and pupae (the most resistant stages) of *E. elutella* were inserted into hogsheads of tobacco at depths of 1·5–9·5 inches and the hogsheads were placed in a vacuum chamber and exposed to a vacuum of 29·5 inches of mercury for five minutes, after which live steam at about 300°F. and a pressure of 95 lb. was slowly admitted until the vacuum was reduced to about 18·5 inches ; the cylinder was again evacuated to a vacuum of 27·2 inches for three minutes, and then air was allowed to enter. The maximum temperature attained in the treated tobacco was estimated as 170–176°F., and the total length of each treatment was about 16 minutes. Mortality of larvae and adults, examined after 24 hours, and of eggs and pupae, examined after ten days, was complete in all tests.

To determine the effect of the vacuum alone, all stages of both species were subjected at room temperature (75°F.) to a vacuum of 29·8 inches, reached in seven minutes, maintained for three minutes and released in two minutes. Adults of *L. serricorne* and eggs of both species were not affected, and larvae and

pupae of *L. serricorne* and larvae, pupae and adults of *E. elutella* suffered only 21, 36, 11, 13 and 8 per cent. mortality, respectively. In no instance was the mortality high enough to approach economic control.

It is concluded that the thermal-vacuum treatment frees tobacco from *L. serricorne* and *E. elutella* and that infestation in storage will not be carried over into the manufactured product.

STAHL (C. F.). **Reaction of Hornworms to certain organic Compounds.**—*J. econ. Ent.* **39** no. 5 pp. 610–612, 1 ref. Menasha, Wis., 1946.

The results are given of laboratory tests carried out in 1943 and 1944 to compare the toxicity of some new organic compounds with that of cryolite to third-instar larvae of *Protoparce sexta*, Joh., and *P. quinquemaculata*, Haw., the two Sphingids that attack flue-cured tobacco in North Carolina. Laboratory-reared larvae were placed on tobacco suckers that had been dusted at a uniform rate and were examined daily for four days. In 1943, cryolite (approximately 90 per cent. sodium fluoaluminate), p-aminoazobenzene hydrochloride, p-aminoazobenzene, phthalonitrile and diazoaminobenzene, all in diatomaceous earth (1 : 1), gave 56, 36, 24, 64 and 22 per cent. mortality of *P. sexta* and 82, 97, 92, 41 and 75 per cent. of *P. quinquemaculata*, respectively, and in 1944 the first four and technical DDT in pyrophyllite (1 : 9) gave 39, 25, 22, 26 and 64 per cent. mortality of *P. sexta* and 40, 94, 94, 41 and 100 per cent. of *P. quinquemaculata*. Natural mortalities were 5 and 1 per cent. in 1943 and 0·35 and 3 per cent. in 1944. It was evident that *P. quinquemaculata* was more susceptible than *P. sexta* to the compounds tested, with the possible exception of phthalonitrile, which gave erratic results, possibly owing to its volatility. The effectiveness of DDT against *P. quinquemaculata* was confirmed in further tests in which treatment with 2·25 per cent. DDT gave complete mortality within 48 hours.

It is concluded that the compounds tested have little value against *P. sexta*, which is the dominant species in the Oxford area of North Carolina, but that where *P. quinquemaculata* is prevalent, diazoaminobenzene, p-aminoazobenzene hydrochloride and DDT may be more effective than any of the arsenical and fluorine insecticides now available.

LATTA (R.). **Field Experiments with Heat-generated Aerosols.**—*J. econ. Ent.* **39** no. 5 pp. 614–619, 3 figs., 1 ref. Menasha, Wis., 1946.

An account is given of investigations in which thermally generated DDT aerosols were applied to woodland in New England for the control of *Lymantria* (*Porthetria*) *dispar*, L. A modified army oil-fog generator [*cf. R.A.E.*, A **35** 121] in which DDT dissolved in cyclohexanone was added to the oil supply, was used in 1944 and a Hochberg-LaMer generator [*cf.* **35** 259], by which an emulsified oil-solution of DDT was applied, in 1945. The first apparatus was operated from a fixed point, but the second was mounted on a truck and moved along the windward side of the plot. Several applications were unsatisfactory because of poor distribution, due to unfavourable atmospheric conditions, but three in May 1944 and four in May 1945 were successful.

From visual observation of the aerosol cloud and from the effect on the larvae of *L. dispar*, it is concluded that, for efficient application of aerosols to forest areas under all the weather conditions tested, a positive air movement in one direction is necessary. With one exception, this was found only when there was a fairly steady wind of ten miles per hour or more above the forest canopy. Such a wind produced turbulence within the forest, which distributed the aerosols to all heights and yet maintained a general downwind direction of movement. The exception occurred at dusk in an apparently dead calm, when good inversion and air drainage down a mountain side provided almost ideal conditions. Local turbulence over roads, down which air tended to flow

regardless of the direction of winds above the canopy, was overcome in one test by the use of a high-velocity blower, which carried the aerosol through the forest to a point beyond the influence of the road. When aerosols were applied from open terrain along the edge of a forest, turbulence such as existed over roads was absent, and the air movement carried the aerosols into the forest satisfactorily. Aerosols applied during light rainfall or after heavy rains were apparently as effective as those applied in dry weather. The residues from aerosols applied when the foliage was very wet or just before heavy rainfall remained repellent throughout most of the season. A dosage of 8 lb. DDT applied from a fixed point by the oil-fog generator did not give complete control except in the immediate vicinity of the point of application, but dosages ranging from 0·063 to 0·36 oz. DDT per foot frontage applied by the Hochberg-LaMer generator gave complete control to the maximum depths investigated, which ranged from 250 to 800 ft., respectively. Reinfestation by migrating larvae began from the back of the plots towards the front. In one treatment over woods in which few eggs had hatched, the numbers of affected larvae collected were 1,064, 209 and 73 on the first, second and third days after treatment and 403, 122 and 439 in the sixth, seventh and tenth ; it is considered that the larvae that dropped during the first three days had been present on the foliage when it was treated, and those that dropped later, which were all in the first instar, were newly hatched and had been killed by crawling up the trunk and over foliage on which there was a DDT deposit. It was found that foliage exposed to aerosols from the Hochberg-LaMer generator was repellent to the larvae ; leaves collected 25 ft. from the point of origin were refused for more than 50 days, those collected 50 ft. away were very repellent until after 36 days, though some feeding occurred in all tests, and those collected 80 ft. away were slightly repellent for 13 days ; untreated leaves were consumed voraciously. The aerosol deposit apparently prevented reinfestation throughout the season by killing or repelling the larvae. It was not determined whether the DDT or some other component of the emulsion was responsible for the repellent action.

Individual trees by roads or in gardens were treated by directing the aerosol with a high-velocity air stream produced by a powerful blower or by using the tendency of the aerosol cloud to rise perpendicularly in a dead calm. Trees were quickly and efficiently covered by the first method, but large spreading ones could be enveloped completely by the second only if it was possible to move the generator about under them, and this increased the expenditure of aerosol.

GUNTHER (F. A.), LINDGREN (D. L.), ELLIOT (M. I.) & LADUE (J. P.). **Persistence of certain DDT Deposits under Field Conditions.**—*J. econ. Ent.* **39** no. 5 pp. 624–627, 1 fig., 7 refs. Menasha, Wis, 1946.

Emulsions of kerosene solutions of DDT give poor initial kill of adults of *Aonidiella aurantii*, Mask., but effectively prevent the development of the crawlers if the deposit of DDT is heavy enough [*cf. R.A.E.*, A **33** 113, etc.]. *A. aurantii* produces its young over a period of several months, however, and investigations were therefore carried out in southern California to determine the persistence of a given initial deposit of DDT under field conditions, the effects on initial spray deposits of the degree of purity of the DDT, the use of auxiliary solvents and the incorporation into the spray mixture of a petroleum gelling agent (aluminium stearate) [*cf.* **35** 123], and also the rates of penetration and of loss of deposit (either by chemical decomposition or the mechanical effect of weather, which were not distinguished). The work was done during the hottest part of the year, since DDT may be heat-labile ; ultra-violet decomposition of DDT was probably also involved.

Mature orange and lemon trees were sprayed with 4 gm. technical or chemically pure DDT per 100 ml. kerosene or 8 gm. technical or pure DDT per 90 ml. kerosene with 10 ml. tetralin or Velsicol AR 60 (a mixture of mono- and di-methyl naphthalenes), both with and without the addition of 1 gm. aluminium stearate, emulsified with blood albumin spreader and diluted to 3 per cent. The DDT deposits on representative samples of 75 leaves from the north and south sides of each tree were analysed at various intervals after spraying, and eight fruits per treatment were collected at weekly intervals, immediately infested with 200–400 crawlers and examined three weeks after infestation. It was found that the deposits of DDT from all sprays prevented the settling and development of crawlers for three weeks, after which a slow decrease in effectiveness was observed, especially in sprays containing technical DDT, and that the period of protection was noticeably longer for the higher concentration of DDT, regardless of its degree of purity. Chemical analysis of deposits substantiated these observations. In general there was a slightly greater decrease in the DDT deposit on the southern, more exposed, than on the northern sides of the trees, although in some instances the initial deposit was actually higher. There were no important differences in the persistence of the two grades of DDT on either orange or lemon. Comparison of the results of the bio-assays on fruits and chemical assays on leaves showed that 12 mmg. DDT per sq. cm. of surface completely prevented the development of the crawlers, whereas less than 7 mmg. had no apparent effect on settling or subsequent development. This quantitative interpretation does not take into account increases in surface area due to normal fruit growth and is based on the assumption that the initial deposits of DDT are of the same order of magnitude on leaves and fruits; the validity of this assumption is being investigated.

The deposits of DDT from sprays containing only kerosene and DDT were found to be up to 40 per cent. greater than the original deposits after 24 hours, indicating that much of the spray penetrated into the leaf tissues almost immediately, carrying the dissolved DDT with it, but slowly returned to the surface, whereupon evaporation of the solvent left a deposit of DDT. Aluminium stearate largely prevented this initial penetration but caused little increase in the surface residue after 24 hours [*cf.* **35** 123]. After the first 24 hours, all deposits of DDT decreased steadily at the rate of approximately 0·25 mmg. per sq. cm. leaf surface per day for the remaining 85 days of the experiment. Neither tetralin nor aluminium stearate seemed to have much effect on the persistence of the DDT deposit, but when the two substances were used in the same spray, about 14 per cent. of the initial deposit was lost within 24 hours. Velsicol AR 60 caused about 16 per cent. loss of the initial deposit within 24 hours. These results suggest that in analyses to determine the effective deposit of DDT, the leaf sample should not be stripped for at least 24 hours after the spray application. Two heavy falls of rain had no demonstrable effect on the deposits, but after 86 days all treatments showed 71–95 per cent. loss of the original quantity of DDT deposited. The highest total decreases were shown by sprays containing aluminium stearate, regardless of the presence of an auxiliary solvent, and in general, total decrease was slightly less for sprays containing chemically pure DDT than for those containing technical DDT.

McLeod (W. S.). **Hexachlorocyclohexane in the Control of Onion Maggot.**—*J. econ. Ent.* **39** no. 5 pp. 631–637, 8 refs. Menasha, Wis., 1946.

Experiments were carried out in Winnipeg in 1945 to test the effectiveness of 29 chemical treatments against *Hylemyia antiqua*, Mg., which had caused heavy losses of onions during the preceding cycle of wet seasons. Liquid seed treatments were applied several days before planting in order to allow thorough drying, and dust seed treatments on the morning of sowing, with sugar syrup

as an adhesive. Sprays and dusts for treatment of the growing plants and soil were first applied either just before oviposition or during the early stages of it, when the plants were about an inch high, and applications were repeated twice at weekly intervals. As soon as maggot damage was observed, injured plants from a one-yard strip were pulled, and the plants and maggots were counted and removed from the field. Six counts were made, from the time of the last application of insecticide until four weeks later, and the number of healthy plants at the end of the season was recorded and the percentages of healthy plants calculated.

The percentages of undamaged plants in the controls were 51·1, 69·6 and 67·6. The most successful treatment (99·8 per cent. undamaged plants) consisted in mixing the onion seed with an equal weight of mercurous chloride (calomel) and dusting the soil and seedlings with 4 per cent. mercurous chloride in talc, but it delayed germination by almost a week, inhibited growth and was expensive. Mixing the seed with mercurous chloride without dusting gave 89·1 per cent. uninjured plants, and dusting without seed treatment 83·9 per cent. Dusting lightly along trenches about $\frac{3}{4}$ in. deep with pure DDT at about 1 lb. per 500 ft. of row, spreading the onion seed on the DDT, covering immediately with soil and trampling gave 99·1 per cent. undamaged plants, but involved much work by hand. Treating the seed with half its weight of pure DDT gave 96 per cent. sound plants, but 0·1 per cent. DDT was worthless as a seed treatment and gave only limited control when applied as a spray to the soil and seedlings, and a 3 per cent. DDT dust on the soil round the seedlings was practically ineffective.

A dust prepared from 20 per cent. benzene hexachloride (hexachlorcyclohexane) and gypsum (1 : 3), containing 0·5 per cent. γ isomer and applied at 2·5 lb. per 500 ft. of row, and sprays prepared from a stock solution of 8 oz. crude benzene hexachloride, 4 fl. oz. Triton X-100 and acetone to make 40 fl. oz., diluted 1 oz. in 100 oz. water (giving 0·02 per cent. γ isomer), alone or with the addition of 10 oz. molasses per gal. spray and applied at 2 quarts per 75 ft. row, gave almost complete protection for two weeks after the last application and 98·4, 97·1 and 98·1 per cent. sound plants, respectively, at the end of the season. All are considered very effective treatments, the dust being the easiest for use. Treatment of the seeds with an equal weight of 20 per cent. benzene hexachloride caused the death of all the seedlings, however, and it is possible that regular application of this compound to the same land for a long period might result in the accumulation of a concentration that would prevent the germination of seeds. The standard spray emulsion of 8 oz. light lubricating oil and 2 gals. Bordeaux mixture (4 : 4 : 40), applied at 1 gal. per 250 ft. row gave 93·3 per cent. undamaged plants and is considered desirable for heavily infested districts until better treatments are available, but a solution of mercuric chloride (corrosive sublimate) in water (1 : 1,600) poured along the rows at 1 gal. per 150 ft. row gave only 75·9 per cent. sound plants. The other materials tested were all less effective.

SMITH (R. F.) & MICHELBACHER (A. E.). **Control of *Lygus* Bugs in Alfalfa Seed Fields.**—*J. econ. Ent.* **39** no. 5 pp. 638–648, 5 figs., 24 refs. Menasha, Wis., 1946.

The authors review previous experiments on the control of Mirids of the genus *Lygus* (*L. hesperus*, Knight, *L. elisus*, Van D., and *L. oblineatus*, Say), which cause important losses of lucerne seed in the west of the United States, discuss the seasonal population trends of the bugs in fields of lucerne grown for seed in California and describe commercial-scale experiments on their control in 1944–45 with dust mixtures containing 0·5–10 per cent. DDT applied with ground power-driven dusters or by aeroplane.

The following is based on their conclusions. During the growth of a seed crop, the population of the bugs normally shows a rather rapid rise to a peak at about the time that the lucerne is in full bloom, followed by a rather abrupt decline. Dusts should be applied so as to eliminate or suppress the population during the period of most rapid increase, usually when it reaches about ten adults and nymphs per sweep of the insect net, though in some cases it is better to wait until the population is still higher. If adjacent hay fields infested by *Lygus* are about to be harvested, dusting should be postponed, so as to avoid the migration of large numbers of bugs into the field after dusting and to minimise the danger of drift of DDT on to the hay crop. There are many fields in which the population does not become large enough to justify dusting.

It appears that DDT gives exceptionally good control of *Lygus* when the actual amount applied is about 1–1½ lb. per acre and that it is more effective against nymphs than against adults. It is considered that the best results will be obtained with a 5 per cent. dust applied at 30 lb. per acre ; a 3 per cent. dust should be applied at 40–50 lb. per acre and a 4 per cent. fused dust of DDT and sulphur at 30 lb. per acre. The carrier appeared to affect the efficiency of the dust, 3 per cent. DDT in pyrophyllite giving a higher initial kill than the same amount in talc, while in other tests, sulphur mixtures were more effective than talc dusts.

DDT does not appear to be harmful to bees in lucerne fields and may actually favour these by increasing the amount of bloom. It eliminated Coccinellid predators in some cases, but predacious Hemiptera, such as *Geocoris* and *Nabis ferus*, L., were numerous in some treated fields. In view of the possible danger to livestock, the straw from dusted fields should not be used as fodder.

Dusts containing 10 per cent. sabadilla were applied in two areas ; they gave encouraging results, but were inferior to DDT.

SHIRCK (F. H.). **Growth of the Sugar-beet Wireworm on different Food Plants.** —*J. econ. Ent.* **39** no. 5 pp. 648–651, 1 fig., 6 refs. Menasha, Wis., 1946.

In experiments carried out in Idaho to find how the food-plants available to larvae of *Limonius californicus*, Mannh., affect their rate of growth, plants of different families were sown in individual pots and infested with single wireworms a month later, when the growing plants had used up all the seed materials and only roots or other underground parts were available for the larvae. The wireworms, which had completed one season's growth in outdoor cages when the experiment was begun, were removed from the pots once a month, weighed and returned to pots containing plants of the same kind. The results obtained during six months indicated that plants vary widely in suitability as food for the larvae. Among cereals, barley, sweet maize and wheat were satisfactory foods, and the rates of growth of the larvae on these plants and on peas were not significantly different. Oats were significantly less suitable than barley, peas and sweet maize but not than wheat. Barley and lucerne planted together ranked significantly below barley alone and significantly above lucerne alone, on which growth was consistently slow. The growth of wire-worms feeding on carrots, sugar-beets, cabbage, cucumber, beans, onions and lettuce was poor and not significantly different from that on lucerne. Only ten of the 360 wireworms pupated, four on barley, two on barley and lucerne, three on sweet maize and one on wheat.

In tests with mature plants of lucerne, red clover [*Trifolium pratense*], sweet clover [*Melilotus*] and oats, the development of the wireworms on red clover was significantly greater than on lucerne and rather greater than on sweet clover. It was less on lucerne than on oats, though the differences were not significant. Growth was more rapid on older plants than on seedlings of the same varieties.

Rice (R. I.), Johnstone (H. F.) & Kearns (C. W.). **A simple Exhaust Aerosol or Spray Generator for dispersing Insecticide Solutions.**—*J. econ. Ent.* **39** no. 5 pp. 652–658, 4 figs., 2 refs. Menasha, Wis., 1946.

The following is based mainly on the authors' summary. The need for simple, efficient equipment to disperse insecticides for controlling mosquitos during the war led to the development of a generator, mounted on a jeep, in which the liquid is injected into the high velocity exhaust gases at the throat of a venturi so that the shearing forces on it effect atomisation. It is released as a spray or aerosol, the droplet size decreasing as the gas velocity is increased and the rate of liquid flow decreased. The equipment consists of an insecticide reservoir, a control valve with indicating dial, a length of flexible hose, a simple clamp cutout, and a sheet-metal venturi nozzle, which is clamped on the exhaust pipe of the engine after the muffler has been removed. The venturi is mounted on the flexible tubing extension, which can be pointed at any desired angle. Insecticide solutions and emulsions made up with solvents having either high or low boiling points were successfully applied with the equipment.

A detailed description is given of the equipment, its installation and the method of operating it when it is installed on a jeep. A similar device installed on the exhaust of light aircraft is also described. The principal use of the equipment so far has been the control of flies and mosquitos with solutions of DDT, but suggestions are made for using it both from the ground and from aircraft for dispersing insecticides to control agricultural pests. On a jeep, it has been used with considerable success for the control of *Melanoplus differentialis*, Thos., and *M. femur-rubrum*, Deg., attacking various crops in Illinois. The jeep was driven at three miles an hour, and concentrated emulsions and solutions were applied in 20–30 ft. swaths at 3 U.S. gals. per acre. The mass median diameter of the droplets was about 50 microns.

Frazier (N. W.). **Injury to Fruit of Plums caused by *Dicerca horni*.**—*J. econ. Ent.* **39** no. 5 p. 660, 3 refs. Menasha, Wis., 1946.

Larvae of the Buprestid, *Dicerca horni*, Crotch, are frequently found mining in the dead or dying wood of broad-leaved forest trees and shrubs and also of stone fruit trees in the United States, but an unusual type of injury caused by the adults was observed on plum trees in California in late April and early May 1946. They girdled the stems of the immature fruits, causing them to drop from the trees, but since most of the injury occurred during the period when the fruits were being thinned by hand, little or no loss resulted. The beetles were common but not abundant, and had not been observed to cause such injury in the orchard before.

Newton (J. H.) & List (G. M.). **DDT to control the Green Peach Aphis.**—*J. econ. Ent.* **39** no. 5 p. 661, 2 refs. Menasha, Wis., 1946.

Since apple trees that had received nine sprays of DDT in 1944 for the control of the codling moth [*Cydia pomonella*, L.] in Colorado showed only 3 per cent. of the fruit spurs infested with *Anuraphis roseus*, Baker, in the spring of 1945, as compared with 42 per cent. on trees that had been sprayed with lead arsenate [*cf.* also *R.A.E.*, A **33** 218], a spray of 0·8 lb. DDT per 100 U.S. gals. water was applied to some of the trees in three peach orchards on 26th September 1945 to determine its effect on *Myzus persicae*, Sulz. Counts made on 28th March 1946 on 800 buds each from treated and untreated trees showed totals of 21 and 377 stem-mothers, respectively ; all the eggs had apparently hatched, and reproduction had begun. Microscopic examination in April showed that there were no Aphids on 238 buds from treated trees, and 48 stem-mothers, 18 young of the first generation and 46 hatched and shrivelled eggs on 231 from

untreated trees. Four Syrphid larvae on the untreated twigs had undoubtedly destroyed several Aphids. The treatment evidently prevented much oviposition, owing either to destruction of the autumn migrants or of the sexual forms that develop from them.

It is considered that autumn treatment with DDT would have many advantages over the spring treatment in Colorado, since weather and labour conditions are then more favourable, water is available and much autumn feeding of the Aphids is prevented. The last is of major importance in view of the recent findings [**36** 79] that *M. persicae* is a vector of the peach-mosaic virus [*Marmor persicae* of Holmes].

Siegler (E. H.) & Gertler (S. I.). **Toxicity of aromatic Esters of Benzenesulfonic Acid to Codling Moth Larvae.**—*J. econ. Ent.* **39** no. 5 p. 662. Menasha, Wis., 1946. **Toxicity of some Alpha Tolunitriles and Glycinonitriles to Codling Moth Larvae.**—*T.c.* p. 670. **Toxicity of aromatic Esters of p-Toluenesulfonic Acid to Codling Moth Larvae.**—*T.c.* p. 674, 1 ref.

In these three papers, the results of tests against larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., by the apple-plug method [*cf. R.A.E.*, A **23** 174] of lead arsenate and 35 organic compounds used at the rate of 4 lb. per 20 U.S. gals. ethyl alcohol (95 per cent.) and 80 U.S. gals. water are given in tables. The parachlorphenyl, ½phenyl, orthotolyl, and orthochlorphenyl esters of benzenesulphonic acid, and orthohydroxy-α-(1-piperidyl)-α-tolunitrile and N-paratolylglycinonitrile were more toxic than lead arsenate, the first two and the last considerably so. The remaining 13 esters of benzenesulphonic acid, nine tolunitriles and glycinonitriles and the seven esters of paratoluenesulphonic acid were less toxic than lead arsenate.

In a small-scale foliage test, N-paratolylglycinonitrile caused no injury to the leaves of apple but severely damaged those of peach.

Siegler (E. H.) & Bowen (C. V.). **Toxicity of Nicotine, Nornicotine, and Anabasine to Codling Moth Larvae.**—*J. econ. Ent.* **39** no. 5 pp. 673–674, 6 refs. Menasha, Wis., 1946.

The results are given of experiments carried out by the apple-plug method [*cf. R.A.E.*, A **23** 174] to compare the toxicity of nicotine, nornicotine and anabasine to *Cydia* (*Carpocapsa*) *pomonella*, L., with that of DDT and lead arsenate. The alkaloids were used in aqueous solutions at a concentration of 0·05 per cent., the DDT (technical) as a suspension at the same concentration, and lead arsenate at 4 lb. per 100 U.S. gals. in water and 95 per cent. ethyl alcohol (4 : 1) or water alone. The average percentages of apple plugs infested and (in brackets) superficially injured were 16 (4) for nicotine, 52 (20) for DDT, 76 (11) and 63 (5) for lead arsenate with and without the alcohol, 83 (1) and 85 (1) for nornicotine and anabasine, respectively, and 92 (0) for no treatment.

Bruce (W. G.). **DDT to control Puerto Rican Mole Crickets.**—*J. econ. Ent.* **39** no. 5 pp. 662–663. Menasha, Wis., 1946.

Scapteriscus vicinus, Scud., caused considerable damage in flower and vegetable gardens on a housing estate in Savannah, Georgia, in 1945 and 1946. The insects were active chiefly at night, when it was difficult to find them, and by April 1946 it was necessary to attempt control measures or to abandon the gardens. Since it was feared that poison baits might injure the plants, a suspension of 1·17 per cent. DDT in water (prepared from a 50 per cent. miscible powder) was applied to the soil of a flower garden with a watering can at the rate of 1 U.S. gal. per 100 sq. ft. This treatment apparently killed all the

mole-crickets in the cultivated soil as damage ceased immediately, but every night a few migrated from the adjacent lawn to the garden, burrowed for a few inches and then disappeared. A week after the first treatment, the same suspension was applied to a four-foot strip of lawn at the edge of the garden, and this completely eliminated the mole-crickets from the latter for the rest of the season, although a flower garden about 20 ft. away continued to be heavily infested.

The same treatment was applied between the rows of plants in a heavily infested vegetable garden in which young tomato plants, beans, peppers [*Capsicum*], cucumbers and squash were severely damaged, and to an adjacent strip of lawn about 4 ft. wide at the rate of approximately 1 U.S. gal. per 100 sq. ft. A little mole-cricket activity was observed for about two days after treatment, but none thereafter for the rest of the season. Care was taken to avoid any deposition of DDT on the cucurbits, and no ill effects were noted on any of the plants grown in the treated soil.

BRETT (C. H.) & RHOADES (W. C.). **Control of the Red Harvester Ant with Velsicol 1068.**—*J. econ. Ent.* **39** no. 5 pp. 663–664. Menasha, Wis., 1946.

The results are given of experiments on the use of technical Velsicol 1068 [chlordane] [*cf. R.A.E.*, A **35** 119] and hexachlorcyclohexane [benzene hexachloride] for the control of *Pogonomyrmex barbatus* var. *molefaciens*, Buckley, a major pest in fields and gardens in Oklahoma. Large well-established colonies were treated with 100 or 200 cc. of solutions of chlordane in carbon tetrachloride or 95 per cent. ethyl alcohol, poured into the mound openings slowly in order that they might drain into the tunnels, and were examined at intervals afterwards. All the concentrations tested (0·5–5 per cent.) stimulated the ants to considerable activity, killing numbers within two hours, and concentrations of 2·5–5 per cent. destroyed colonies within 24 hours with no repellent effect and no establishment of new nests. A water suspension of benzene hexachloride diluted to contain 1 or 2 per cent. γ isomer and applied in the same way killed large numbers of ants at the time of application, but was repellent, so that parts of the colony made new entrances and established two or three new nests near the original one. Barriers of benzene-hexachloride dust (5 per cent. γ isomer) round the mounds killed many of the ants that crossed them within the first 72 hours and were also repellent during this period, but after it, ants crossed the dust readily and showed no effects. No colonies were completely destroyed by benzene hexachloride.

In a general control programme, over 300 colonies were destroyed by pouring about 200 cc. of a 3 per cent. solution of chlordane into each nest. Carbon tetrachloride and 95 per cent. alcohol were used as solvents, but solutions in petroleum oils and water suspensions were found to be equally effective. The toxic effect of chlordane on warm-blooded animals was not known, but it was used cautiously and had no effect on the operators other than a slight irritation of the nose and eyes caused by the fumes from the concentrate.

ROMNEY (V. E.). **Control of *Lygus* Bugs with DDT as related to Guayule Seed Production.**—*J. econ. Ent.* **39** no. 5 pp. 664–665, 5 refs. Menasha, Wis., 1946.

An experiment was carried out in California in 1945 to determine the effect on the quality and quantity of the seed produced by guayule [*Parthenium argentatum*] of dusting field plots often enough with DDT to keep populations of *Lygus hesperus*, Knight, comparatively low. A 2·5 per cent. DDT dust, made by diluting a commercial 10 per cent. dust with pyrophyllite was applied at 30–35 lb. per acre on 28th May, 11th June, 12th and 26th July and 25th

August. It killed most of the adults and nymphs present at the time of application, but had little effect on nymphs that hatched subsequently; there was also considerable immigration of adults from untreated plots. Two generations of the bug were present. Seed was collected by hand between 7th July and 29th September as often as was necessary to prevent excessive loss from shattering, and was cleaned, threshed and poured into acetone, in which empty seeds float and sound ones sink. The total weight of cleaned seed from 30 plants averaged 414·3 gm. for treated plots and 303·7 for untreated ones, and the average percentage of filled seed was 40·6 for treated plots and 14·3 for untreated ones. Since only 50 per cent. of the seeds of the variety of guayule used germinate under favourable conditions whereas 95–98 per cent. of the seeds that sink in acetone are viable, the proportion of sound seed in the treated plots was considered high. The amount and quality of seed in the untreated plots decreased rapidly after the beginning of September, whereas heavy production of high-quality seed was maintained in the treated ones. In the treated plots, the weight of 500 seeds decreased on the last two collection dates, while the amount of sound seed remained high, owing to the fact that smaller seeds were produced by the plants at that time.

CHANDLER (S. C.). **Unsatisfactory Control of Plum Curculio in Illinois with Dichloroethyl Ether.**—*J. econ. Ent.* **39** no. 5 pp. 666–667. Menasha, Wis., 1946.

The results are given of experiments carried out in Illinois in 1946 in which dichlorethyl-ether emulsion applied once or twice in June to the soil round peach trees for the control of the plum curculio [*Conotrachelus nenuphar*, Hbst.] appeared to be of very little value. The concentrations and rate and timing of application of the emulsion were the same as those used by Snapp in Georgia [*R.A.E.*, A **34** 335–336]; the great inferiority in the control obtained may have been due to grass and weeds preventing the emulsion from reaching the ground readily in the first application, when the soil was not disked, or to the type of soil, which may have prevented its adequate penetration.

DITMAN (L. P.). **DDT Aerosols to control Worms in Corn.**—*J. econ. Ent.* **39** no. 5 p. 668, 1 fig. Menasha, Wis., 1946.

The results are given of preliminary tests carried out in Maryland in 1945 to determine the effectiveness of DDT aerosols in protecting ears of sweet maize from *Heliothis armigera*, Hb., *Pyrausta nubilalis*, Hb., and *Laphygma frugiperda*, S. & A. A solution of DDT, methyl chloride, Velsicol AR-60 [essentially a mixture of mono- and di-methyl naphthalenes] and acetone (5 : 50 : 10 : 35) was released from a knapsack dispenser fitted with three oil-burner nozzles on each side, the middle ones being at the height of the average ear, carried between the rows at a rate of about three miles an hour.

In the first test, the aerosol was applied by carrying the dispenser either between every pair of rows or between alternate pairs on 14th August, when the ears were small and the silks had not begun to appear, on 22nd August, when silks were appearing and on 28th August after all silks were out, or on 28th August only, and the crop was harvested on 11th September. In the second, the same treatments were applied to heavily infested late sweet maize on 31st August, when silks were first appearing, and on 4th September, after all the silks were out, and the crop was harvested on 21st September. The treatment was ineffective against *H. armigera* and *P. nubilalis*, but reduced the percentage of ears infested by *L. frugiperda* from 21·4 to 0·9 and 1·3 for three applications and to 12·2 and 14·3 for one in the first test and from 45·2 to 1·4 and 3·5 in the second.

L. frugiperda is a limiting factor in the production of autumn sweet maize in southern Maryland, and the effectiveness of the treatment against it may be due to its habit of moving about freely on the plant. The aerosol caused no serious plant injury.

PACKARD (C. M.). **DDT Dusts and Sprays, and Bran Baits containing different Poisons, for Armyworm Control.**—*J. econ. Ent.* **39** no. 5 p. 669. Menasha, Wis., 1946.

In tests carried out in Virginia in 1945, dusts containing 2 and 10 per cent. DDT in pyrophyllite and a spray of 2 lb. DDT (as a water-dispersible powder) per 100 U.S. gals. water, applied about 6 p.m. on 27th April, and one of 5 per cent. DDT in kerosene, applied at 1 p.m. on 29th April, were not very effective against larvae of *Cirphis unipuncta*, Haw., in a heavily infested field of tall, headed-out rye. The first three treatments left DDT residues of 3·3, 3·3 and 3 parts per million on the rye at harvest.

Baits of 25 lb. wheat bran with 1 lb. Paris green, calcium arsenate or sodium fluosilicate or 1½ lb. calcium arsenate or cryolite, made into a crumbly mash with water and applied to one-acre plots in the same field between 5 and 6.30 p.m. on 28th April resulted in 81, 26, 80, 24 and 18 per cent. mortality of the larvae on 29th April and 94, 81, 91, 93 and 38 per cent. on 30th April, as compared with 1 and 0 per cent., respectively, for no treatment. It is concluded that Paris green and sodium fluosilicate are very effective in baits against *C. unipuncta* [*cf. R.A.E.*, A **32** 372 ; **34** 340], that calcium arsenate is effective but much slower in action, and more effective at a concentration of 6 : 100 than at 4 : 100, and that cryolite at the rate used is comparatively ineffective.

SHARP (S. S.). **Metastability and the Efficiency of Azobenzene as a Fumigant.**—*J. econ. Ent.* **39** no. 5 pp. 669–670, 2 refs. Menasha, Wis., 1946.

In view of Blaurett's finding that volatilised azobenzene is effective in controlling red spiders [*Tetranychus*] in greenhouses [*cf. R.A.E.*, A **35** 180], tests were carried out to determine its physical state after it comes in contact with a surface. Azobenzene was volatilised into a bell-jar containing glass sides, house-fly wings and lucerne leaves suspended at various levels, and these were removed for microscopic examination five minutes after volatilisation was complete. It was found that the azobenzene formed on the surfaces in an even pattern of very finely divided drops and that these drops remained liquid for several hours, even though they were kept at 40–45° below the freezing point (68°C.) of the compound. The finer drops slowly evaporated without crystallising and the larger ones finally crystallised. Comparable results were obtained when the azobenzene was volatilised in a 125 cu. ft. fumigation chamber. It is suggested that the efficiency of azobenzene as a fumigant is due to its metastability, or ability to remain in the liquid state below its freezing point, the fine, mist-like liquid particles that settle offering maximum opportunity for contact with the cuticle and for subsequent penetration.

ROMNEY (V. E.). **Insects found on Guayule in northern Mexico.**—*J. econ. Ent.* **39** no. 5 pp. 670–671, 1 ref. Menasha, Wis., 1946.

The results are given of a survey of insects attacking native and cultivated guayule (*Parthenium argentatum*) in its natural habitat in northern Mexico, carried out from 14th to 23rd June 1945. The insects reported from this plant in Mexico by F. E. Lloyd (1911) were the Coccids, *Puto* (*Ceroputo*) *yuccae*, Coq.,

Rhizaspidiotus (*Targionia*) *dearnessi*, Ckll., and *Orthezia* sp. from the roots, and the Scolytid, *Pityophthorus nigricans*, Bldf., tunnelling under the cortex of a harvested shrub.

No Coccids were found on cultivated guayule by the author, but *Targionia yuccarum*, Ckll., and a species resembling *R. dearnessi* were widely distributed on the roots of native shrubs and caused stunting of heavily infested plants, and *Lecaniodiaspis* sp., *Tachardiella cornuta*, Ckll., and an unidentified mealybug were sufficiently abundant on the aerial parts of some plants to interfere with growth. Adults and larvae of *Pityophthorus mexicanus*, Blkm., which may be the species recorded by Lloyd as *P. nigricans*, were common in baled shrubs, and larvae of Anobiids of the genus *Vrilletta*, and of Buprestids of the genera *Chalcophora* and *Dicerca* were also found in them. Larvae of a species of *Eucosma* bored down the roots of native shrubs, feeding on the live root tissues and apparently weakening but not killing the plants; they were occasionally found in baled shrubs. The grasshoppers, *Encoptolophus pallidus*, Brun., *Platylactista azteca*, Sauss., and *Trachyrhachys kiowa*, Thos., were collected from a plot of cultivated shrubs. *Lygus* bugs were rare on guayule flowers in Mexico during June 1945, but a few individuals of *L. oblineatus*, Say, were observed on nursery plants in one locality, where another Mirid, *Poeciloscytus* (*Polymerus*) *basalis*, Reut., was abundant. The Jassid, *Cloanthanus heldoranus*, Ball, was common on both cultivated and native plants, and two species of *Empoasca* were common in cultivated plots in two localities. The Issid, *Hysteropterum sepulchralis*, Ball, was reproducing on wild shrubs rather generally throughout the areas surveyed.

COMPERE (H.). **Vegetable Weevil Parasites from South America and their Colonization in California.**—*J. econ. Ent.* **39** no. 5 pp. 671–672. Menasha, Wis., 1946.

The introduction of parasites of *Listroderes obliquus*, Gylh., from South America to California is difficult because the weevil has only one generation in the year and the adults begin their summer diapause in about September in the southern hemisphere and in April–May in the northern. The four species that have so far been introduced from Argentina and Uruguay are the Tachinid, *Epiplagiops littoralis*, Blanch. [*R.A.E.*, A **31** 319], the Ichneumonids, *Porizon parkeri*, Blanch., and *P. argentinensis*, Blanch. [*cf.* **34** 104, 462, note] and a Braconid of the genus *Triaspis* [*cf.* **34** 179]. The two species of *Porizon* were collected in September and October 1942–45 and reached California in October–December, most of them in the early stages of the summer diapause. Over 12,500 cocoons were received, and about 800 adults emerged during the winter, when host larvae were available. They were mated and allowed to oviposit in larvae in the insectary, after which they were released; in addition, 1,271 parasitised larvae were liberated in fields and orchards in which food was abundant during 1945–46. About 2,000 adults and puparia of *E. littoralis* were also sent. The puparia gave rise to adults during the journey or soon after arrival, and most of the flies died before late November or early December, when host larvae were obtainable in California. Those that survived until December reproduced in the insectary, and 7,319 adults were released in heavily infested localities, chiefly during the winter of 1943–44. The parasite was also liberated in the egg and larval stages; no recoveries have been made. In the insectary, *E. littoralis* reproduced generation after generation as long as host larvae were obtainable; it is not known how it survives in their absence during the summer. Only limited numbers of *Triaspis* were received. Adults that emerged during the journey readily oviposited in larvae of *L. obliquus*, but the young did not develop beyond the pupal stage. A few adults were released in one infested orchard.

Newcomer (E. J.), Dean (F. P.) & Carlson (F. W.). **Effect of DDT, Xanthone, and Nicotine Bentonite on the Woolly Apple Aphid.**—*J. econ. Ent.* **39** no. 5 pp. 674–676, 2 refs. Menasha, Wis., 1946.

Since apple trees at Yakima, Washington, that had been sprayed six times in 1944 with 8 oz. DDT per 100 U.S. gals. had 31 per cent. of the leaf nodes on new growth heavily infested by *Eriosoma lanigerum*, Hsm., which had been of little importance since the introduction of the parasite, *Aphelinus mali*, Hald., whereas trees similarly sprayed with 3 lb. lead arsenate per 100 U.S. gals. had only 9·5 per cent. infested, and that lightly [*cf. R.A.E.*, A **34** 75, 107], a record was made in 1945 of the infestation by *E. lanigerum* on trees sprayed with various mixtures. All trees received a calyx spray of lead arsenate, and two plots of Rome apples six cover sprays of the experimental mixtures and one plot of Winesaps seven. All spray quantities are per 100 U.S. gals., and two of the DDT mixtures were tested only in the first plot of Rome apples. The percentages of infested leaf nodes in the three plots were 10, 8·6 and 11·1 for cover sprays of 3 lb. lead arsenate, 1–2 U.S. quarts emulsible mineral oil and 2·67 oz. colloidal spreader, and 12, 20·1 and 33·4 when 4 oz. DDT replaced half the lead arsenate in this mixture ; 1·9, 2·1 and 3·1 for 2 lb. 14 per cent. fixed nicotine, 1–2 U.S. quarts mineral oil, 4 oz. oleic acid and 2 oz. aluminium sulphate, and 12 (first plot only) when 4 oz. DDT replaced half the fixed nicotine ; 0·3, 0·1 and 0·5 for two cover sprays of the nicotine mixture without DDT followed by sprays of 2 lb. xanthone, 1 U.S. quart stove oil and 8 oz. colloidal spreader, and 1·8, 1·9 and 4·4 when 4 oz. DDT replaced half the xanthone in this programme ; and 16·9 (first plot only) for 8 oz. DDT and 1·5 lb. pyrophyllite. In late July, the percentage parasitism by *A. mali* was 45 for the complete lead-arsenate programme, about 30 for DDT and pyrophillite and about 22 for a similar treatment. The control afforded by xanthone was striking [*cf.* **32** 364], and a small test was made in the autumn of 1945 to determine whether xanthone or the stove oil used with it killed the Aphids at the time of application. Heavily infested twigs were thoroughly wet on 28th September and 23rd October with the full xanthone spray or with the same spray with either the xanthone or the stove oil omitted. No mortality occurred, and although it is possible that xanthone would kill *E. lanigerum* in hot weather, it is more probable that it prevents the young Aphids from settling on the bark.

It is concluded that the continued use of DDT on apple trees throughout a season in the Pacific Northwest causes greatly increased infestation by *E. lanigerum*, apparently by interfering with the normal activity of *Aphelinus mali*, that nicotine bentonite reduces the numbers of Aphids when used periodically during the season, so that they would not be a problem if it were used, and that xanthone is even more effective.

Gerberg (E. J.). **DDT to control** *Mezium americanum*.—*J. econ. Ent.* **39** no. 5 p. 676. Menasha, Wis., 1946.

In order to control *Mezium americanum*, Lap., which was living, presumably as a scavenger, in cracks and accumulated dirt in a large baking establishment in Maryland, all walls, beams and studs were thoroughly sprayed with a 4 per cent. DDT solution. A highly refined hydrocarbon distillate was used as the carrier and solvent in order to eliminate contaminating odours and unsightly stains. Examination five days later revealed large numbers of dead adults of the Ptinid and also many other dead and dying insects, and it is concluded that this is an efficient and economical means of reducing infestations in bakeries and warehouses.

Brown (A. W. A.) & Putnam (L. G.). **Grasshopper Control by Oil Solutions of DNOC sprayed from Aircraft.**—*J. econ. Ent.* **39** no. 5 pp. 676–677. Menasha, Wis., 1946.

Details are given of an experiment in Alberta in which a 10 per cent. w/w solution of dinitro-ortho-cresol in oil was emitted at the rate of 3½ gals. per second from an aeroplane flying at 200 miles an hour, approximately 150 feet above ground, in three runs over a strip of Russian thistle [*Salsola*] and pigweed one mile long and 220 yards wide, heavily infested with *Melanoplus mexicanus mexicanus*, Sauss. The coverage of the spray over the field was reasonably even, all sampling points showing some deposit and none more than 3·5 lb. per acre, the average being 1·08 lb. per acre. The quantity of spray used contained 131 lb. dinitro-o-cresol, representing an average expenditure of 1·64 lb. per acre. The average grasshopper population was reduced from 7·02 to 1·67 per sq. yard.

In a previous trial, heavy dosages caused no scorching of foliage of Russian thistle or pigweed until the area deposit exceeded 5–10 lb. per acre. In one field trial, a single run of the aeroplane emitting 10 per cent. dinitro-o-cresol in oil caused complete mortality of grasshoppers exposed on cards over a swath varying from 30 to 80 yards in width, and one in which the aeroplane made two parallel runs at an altitude of only 50 ft., so that the swaths were dense and narrow, resulted in 44 per cent. reduction of a population estimated at 15·8 per sq. yard.

It is concluded from these experiments and laboratory tests that more than 90 per cent. control of *M. mexicanus* could be expected if all points in an area were covered at a rate of more than 0·3 lb. per acre and 100 per cent. control if the rate were greater than 0·5 lb.

Brett (C. H.) & Rhoades (W. C.). **Grasshopper Control in Alfalfa with Hexachlorocyclohexane Dust.**—*J. econ. Ent.* **39** no. 5 pp. 677–678, 1 fig. Menasha, Wis., 1946.

Lucerne fields in north-western Oklahoma, infested with *Melanoplus differentialis*, Thos., *M. bivittatus*, Say, and *M. mexicanus*, Sauss., at an average rate of 35–40 per square yard, were treated with technical benzene hexachloride (hexachlorcyclohexane), which contained 10 per cent. γ isomer, or technical Velsicol 1068 [chlordane] in dusts when the lucerne was about 15 inches high and nearly ready to cut, at temperatures of 80–95°F. and an average humidity of less than 50 per cent. A wettable powder containing 50 per cent. benzene hexachoride applied at 38 lb. per acre, gave complete kill, and mixtures of 80, 60, 40, 20, 5, 1 and 0·5 per cent. benzene hexachloride with talc applied at 10 lb. per acre gave 84, 57, 33, 22, 14, 7 and 0 per cent. mortality, respectively. At the higher concentrations the dusts caused symptoms of poisoning within a few minutes, the interval increasing as the concentration decreased; the 1 per cent. dust did not produce symptoms for four hours. After 24 hours all affected grasshoppers were either dead or had recovered. The benzene hexachloride appeared to have little lasting effect, grasshoppers moving into the treated areas being unaffected, so that the population was restored at the end of two weeks. Nymphs and adults were about equally susceptible, but it is probable that different species vary in susceptibility, as no living examples of *M. mexicanus* were collected from any plots treated with more than 5 per cent. benzene hexachloride 24 hours after its application. Preliminary tests showed that the use of synergists such as pyrethrins and piperonyl cyclohexanone increased the kill of grasshoppers with the lower concentrations of benzene hexachloride and decreased the time of kill. Dusts of 10 and 5 per cent. chlordane applied at 10 lb. per acre gave only 7·7 and 3·7 per cent. mortality, and lower concentrations had no effect.

Other insects that were killed in the plots dusted with benzene hexachloride included *Eleodes opaca*, Say, *Epicaerus imbricatus*, Say, *Hippodamia convergens*, Guér., *Cicindela punctulata*, Ol., Carabids, larvae of *Colias eurytheme*, Boisd., and *Loxostege similalis*, Gn., *Udeopsylla* spp., *Pogonomyrmex* sp. and Diptera. Jassids were less effected than any other insects that were present in numbers. No phytocydal effect was noticed.

FRANKLIN (H. J.). **The Cranberry Station, East Wareham, Massachusetts.**—*Bull. Mass. agric. Exp. Sta.* no. 428 (Rep. 1944–45) pp. 28–30, 1 ref. Amherst, Mass., 1945.

In June 1944, *Tlascala finitella*, Wlk., was again numerous in the cranberry bog in Massachusetts previously infested by it [*R.A.E.*, A **34** 51, etc.], but cryolite applied as a dust at 50 lb. per acre gave excellent control. In the south-eastern section, infestation by the gipsy moth [*Lymantria dispar*, L.] was relatively heavy, and *Mineola* [*vaccinii*, Ril.] was more abundant and injurious than for many years [*cf. loc. cit.*] except in one county. *Agrotis* (*Euxoa*) *ypsilon*, Hfn., became numerous after summer flooding, and *Crambus* [*hortuellus*, Hb.] was injurious, probably as a result of reduced resanding and autumn flooding. Larvae of *Cirphis unipuncta*, Haw., appeared in numbers on many bogs from which the winter flood water was drawn off as early as 20th May in the spring of 1945.

In experiments on control, a dust of 20 per cent. sabadilla used at a rate of 75 lb. per acre was completely effective against *Rhopobota* [*naevana*, Hb.] ; at 100 lb. per acre it was moderately effective against *Ophiola* [*vaccinii*, Van D.], of no value against *Mineola* and killed only about 66 per cent. of adults of *Crambus*. A dust containing 3 per cent. DDT applied at a rate of not less than 50 lb. per acre gave complete control of *Ophiola* and fully grown larvae of *L. dispar*. A 5 per cent. DDT dust at 100 lb. per acre gave 80 per cent. control of *Mineola* and about 75 per cent. mortality of small larvae of *Crambus*. DDT did not injure the plants but is not recommended for use on cranberry bogs owing to the risk to bees.

ALEXANDER (C. P.) & others. **Department of Entomology.**—*Bull. Mass. agric. Exp. Sta.* no. 428 (Rep. 1944–45) pp. 33–43. Amherst, Mass., 1945.

Although 66 per cent. of the fruits in unsprayed apple plots at Amherst, Massachusetts, were scarred by the plum curculio [*Conotrachelus nenuphar*, Hbst.] in 1944, lead-arsenate sprays timed according to temperature ranges generally gave satisfactory control; where DDT was substituted for lead arsenate, 35·6 per cent. of the fruit was injured. The percentages of apples damaged by the codling moth [*Cydia pomonella*, L.] were reduced to 15, 13 and 5 by the standard schedule alone and with one and two applications of fixed nicotine, to 3 by a schedule employing DX-nicotine [*R.A.E.*, A **33** 149] with a reduced dosage of lead arsenate, and to 1·4 by an additional application between the second and third cover sprays [*cf.* **34** 52]. A DDT spray reduced damage to 10 per cent., and was slightly superior to the standard schedule against the apple maggot [*Rhagoletis pomonella*, Walsh]. In investigations at Waltham on the control of *Conotrachelus* in a heavy crop of apples, 1¼ U.S. gals. spray per 100 sq. ft. of tree area was more effective than 1 U.S. gal., which gave inconsistent results, or ¾ U.S. gal., which was unsatisfactory [*cf.* **34** 52] ; the superiority of the highest rate was even more marked in trials against *Cydia*. Many of the fallen apples infested with *Conotrachelus* were scorched by the sun during hot weather in late June and early July, and the numbers of larvae that emerged from normal fruits and those that were completely or half scorched were 39·4, 0·2 and 2·66 per 100 fruits, respectively. Outbreaks of the leaf-miner, *Lithocolletis blancardella*, F., caused serious injury to the foliage and

accentuated damage by drought in a few apple orchards in which infestation had been light in 1943 [*cf.* **34** 52]. Orchards that were heavily attacked in 1943 had little or no infestation in 1944, probably owing to the action of parasites ; six species were reared from this Tineid.

A spray of DN-111 and a dust of D-4 [preparations containing a dicyclohexylamine salt of dinitro-o-cyclohexylphenol, the concentration in the dust being about 1·5 per cent.] were again found to give reliable control of the European red mite [*Paratetranychus pilosus*, C. & F.] when properly applied during the summer [*cf.* **34** 52]. Populations of mites that had reached an average of 175 per leaf by early July following repeated applications of DDT were reduced in 24 hours to an average of 1·5 per leaf by one application of DN-111, and did not increase again later. Heavy infestations on beach plums [*Prunus maritima*] were almost eliminated by this material and D-4. Apple trees of three varieties that received five applications of DN-111 with wettable sulphur and lead arsenate between 20th May and 11th August were not scorched, but the weather during 1944 did not favour spray injury ; peaches, plums and cherries were not injured by two applications on 29th May and 13th July. In tests in which DN-111 and D-4 were applied to ten ornamentals on different dates, injury was severe following treatment on 31st May, but became progressively less so when the applications were made in early and late June, and little or no injury resulted, even on susceptible varieties, in July. When apple trees at Waltham that were lightly infested with overwintering eggs of *P. pilosus* were given a dormant spray of miscible oil (3·3 per cent. actual oil) or 3 lb. dinitro-o-cresol per 100 U.S. gals., the numbers of active mites per 100 spurs on 16th May were reduced from 170 to 39 and 129, respectively ; by 1st August, however, there was no significant difference in the numbers on sprayed and unsprayed trees. Gesarol A-20 [a spray powder containing 20 per cent. DDT with wetting agent] at a concentration of 4 lb. per 100 U.S. gals. controlled the black scale [*Saissetia oleae*, Bern.] on *Gardenia* and prevented re-infestation. It was less effective at an unstated concentration against the rose chafer [*Macrodactylus subspinosus*, F.] than Gesarol A-3 [a 3 per cent. DDT dust] in laboratory tests in which the beetles were placed on lightly-treated grape-leaves, when mortality after six days was 50 and 90 per cent., respectively; a heavy application of the dust killed 80 per cent. of the beetles in two days and 90 per cent. in three. When both beetles and leaves were treated, 90 per cent. of the sprayed and all the dusted beetles were dead in two days, and when treated beetles were placed on untreated leaves, 74 per cent. of the sprayed and 80 per cent. of the dusted beetles died in two days and all were dead in five. The percentage mortality among untreated beetles was 4 in two days, 5 in three and 10 in five. In tests against adults of the Japanese beetle [*Popillia japonica*, Newm.], the DDT dust and spray gave complete mortality in two days and a thiocyanate preparation (Lethane B-72) 20 per cent. mortality, with most of the survivors inactive, but a cryolite spray and a rotenone dust had no effect. Mortality among the controls was 3 per cent. Adults of the striped cucumber beetle [*Diabrotica melanocephala*, F.] became inactive shortly after treatment with DDT and died in 24 hours ; the treatment did not injure the foliage, but it was not applied until the plants had made good growth, since the beetles did not appear until late in the season. In small-scale laboratory tests, DDT was highly toxic to the young nymphs of the squash bug [*Anasa tristis*, Deg.], but not to those that were more than half-grown ; the adults were only slightly affected.

In tests of the relative susceptibility of cucurbits to attack by the squash vine borer [*Melittia cucurbitae*, Harr.], the numbers of injuries per vine averaged 3·31 on three types of squash that are varieties of *Cucurbita maxima* and 2·33 on six varieties of *C. pepo* (pumpkin, gourd and four types of summer squash). Cucumber, cantaloupe (*Cucumis melo*), butternut squash (*Cucurbita moschata*) and watermelon (*Citrullus vulgaris*) were not attacked.

Though overwintering larvae of the European corn borer [*Pyrausta nubilalis*, Hb.] were numerous in the spring of 1944, infestation of early sweet maize was not serious, since pupation was retarded by hot dry weather in May and oviposition was also hindered by unfavourable weather. A DDT spray (2 lb. Gesarol A-20 per 100 U.S. gals.) and the 3 per cent. DDT dust gave almost complete control, and Black Leaf 155 [14 per cent. fixed nicotine] and derris (4 per cent. rotenone) at 3 and 4 lb., respectively, per 100 U.S. gals., both gave over 97 per cent. control, but infestation was too light (1–2 larvae per plant) to show significant differences between treatments.

Infestation of potato by flea-beetles [*Epitrix cucumeris*, Harr.] was relatively light during June–July, but populations increased in late July and remained high until mid-August, after which they decreased rapidly and caused little damage. An outbreak of potato Aphids began in mid-July, but was suppressed by the inclusion of nicotine sulphate in sprays applied on 20th July. Potatoes planted on 9th May were sprayed at approximately weekly intervals between 12th June and 28th August with Bordeaux mixture (10 : 10 : 100 and 5 : 10 : 100) alone or with the addition of 4 lb. calcium arsenate or 2 lb. Gesarol A-20 per 100 U.S. gals. Plants that received the weaker Bordeaux mixture began to die down in late August or early September and produced an average yield of 320 bushels per acre, whereas those that received the standard spray remained green until killed by frost in early October and gave an average yield of 369 bushels. The addition of the DDT or calcium arsenate to the standard spray increased the yield by about 20 bushels per acre; the addition of calcium arsenate caused an immediate reduction of nearly 50 per cent. in damage by *E. cucumeris*, and maintained it at this ratio for nearly six weeks, and DDT, though not so immediately effective, ultimately caused a marked reduction in the numbers of leaf punctures. The weaker Bordeaux mixture was almost as effective against *E. cucumeris* as the standard, but the addition to it of DDT or calcium arsenate did not appreciably increase the degree of immediate protection, though there was some evidence of a cumulative effect from successive applications.

In tests on the control of the onion thrips [*Thrips tabaci*, Lind.], the dust (D-4) containing the salt of dinitro-o-cyclohexylphenol reduced infestation by 97·5 per cent., but slightly scorched the plants. A thiocyanate dust (Lethane B-71) reduced it by 78 per cent., and the 3 per cent. DDT dust by 44 per cent., and both these materials gave more than 88 per cent. reduction when applied very heavily. Sprays of nicotine sulphate with pine tar soap and derris powder with a wetting agent gave 97 and 95–97 per cent. reduction, and the latter prevented re-infestation. A spray of DDT (Gesarol A-20) gave 91·4 per cent. control with a wetting agent and 87 per cent. without. None of the sprays injured the plants. The numbers of eggs laid by adults of the cabbage maggot [*Hylemyia brassicae*, Bch.] on different varieties of cabbage between 6th and 31st May ranged from 14 to 29; most were deposited on the variety that showed least injury, so that its resistance appears to depend on its ability to withstand damage and not on repellence to the flies. The use of tar paper disks and of a dust containing 4 per cent. mercurous chloride (calomel) in talc [**33** 178] both gave over 90 per cent. control, and two applications of a solution of mercuric chloride (corrosive sublimate) (1 : 1,280) gave 84 per cent. Talc alone was ineffective and the two mercury compounds were unsatisfactory against a heavy infestation when the concentrations were halved. *Lygus campestris*, L., was much less abundant on celery than in previous years [**34** 53], and, with infestations averaging about 20 bugs per 100 plants, 2–3 applications of insecticides gave excellent protection. A dust containing 0·2 per cent. pyrethrins with or without sulphur and the thiocyanate dust (Lethane B-71) both gave complete control of the bug after each application and a dust containing 0·5 per cent. rotenone was satisfactory.

Preparations of dinitro-o-cyclohexylphenol containing 20 and 13·3 per cent. active ingredient applied at concentrations of 8 and 12 oz. per 100 U.S. gals. water, respectively, to greenhouse roses both killed about 97 per cent. of the red spider mite [*Tetranychus*], and it is therefore concluded that a definite concentration of dinitro-o-cyclohexylphenol is required for this purpose. Proprietary sprays containing naphthalene and azobenzene both gave excellent control, but injured the foliage, and others containing extract of yam bean [*Pachyrhizus erosus*] and β-butoxy-β′-thiocyanodiethyl ether were inconsistent and in general unsatisfactory. In preliminary tests, α-bromo-naphthalene appeared promising as a greenhouse fumigant against this mite, but caused some plant injury.

Details are given of tests at several places in which sprays were applied to piles of elm logs to prevent or control infestation by Scolytids (*Scolytus multistriatus*, Marsh., and *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh.) [*cf.* **34** 54]. A mixture of orthodichlorbenzene and fuel oil (1 : 8) usually gave complete protection and control, and was superior to Gesarol SH5 (5 per cent. DDT in a summer oil) in most tests. When applied to individual elm logs, mixtures of orthodichlorbenzene and fuel oil (1 : 8 and 1 : 12), strained mixtures of creosote and kerosene (1 : 4 and 1 : 8), Gesarol SH5 and kerosene (1 : 200 and 1 : 100) and kerosene alone gave complete protection against *Hylastes* when applied just prior to adult flight in spring and were superior to Gesarol SH5 in water (1 : 100 and 1 : 200). Orthodichlorbenzene and fuel oil was the best of 18 sprays applied to individual logs in another locality in mid-June, when attack by *Scolytus* was beginning, but none gave complete protection, and it gave 99·9 per cent. control of *Hylastes* breeding in individual logs, as compared with 97·6 per cent. for creosote and kerosene (1 : 4) and 91·1 per cent. for kerosene alone.

In other tests, logs lying in a north–south direction were rolled over at intervals so that alternate sides were exposed to the sun, and the control obtained was estimated by counts of exit holes per sq. ft. of bark. Rolling newly-felled logs 3–13 ins. in diameter every week during the early oviposition period (18th May–23rd June) [*cf.* **34** 55] gave 99·7 per cent. control of *H. rufipes*; and rolling logs 4–21 ins. in diameter every three weeks during the same period gave 93·5 per cent. control. In another locality, rolling logs up to 7 ins. in diameter at either interval between 10th June and 15th July gave complete control. At both places, the galleries reached a more advanced stage of development in logs turned every three weeks; there were generally more in large logs than in small ones and none at all in either treated or untreated logs less than 5 ins. in diameter. When rather more than half the circumference of newly-felled uninfested logs 3–14 ins. in diameter was sprayed with a strained mixture of creosote and kerosene (1 : 4) in spring and the logs were then rolled over so that the unsprayed side was exposed to the sun, only a small patch of unsprayed bark on one log became infested. Logs less than 10 ins. in diameter that were similarly treated on 2nd July 1943 and exposed throughout 1944 did not become infested, but since the controls also remained free from attack, it is assumed that the wood had become too well seasoned to be favourable. This method gave complete control in another district when applied to logs up to 7 ins. in diameter. When winter-cut logs about 18 ins. long and 2–8 ins. in diameter were piled, before oviposition by *H. rufipes* began, in two barns with large doors that were often open and the basement of a building with a small door that was generally shut, 96·4, 99·5 and 99·6 per cent. control resulted, respectively, as compared with logs piled outdoors in the shade. It is pointed out that beetles may fly to logs after they are stored and that *H. rufipes* overwintering in the trunks of living elm trees may be introduced with logs cut during winter, but the dry conditions indoors are unfavourable for the development of beetles that become established in this way.

Brown (W. J.). **Some new Chrysomelidae, with Notes on other Species (Coleoptera).**—*Canad. Ent.* **78** no. 3 pp. 47–54, 12 figs. Guelph, Ont., 1946.

Lilioceris lilii, Scop., which had not previously been recorded from North America, was found to be well established in Montreal in 1945, when it damaged *Lilium regale* in three gardens more than a mile apart. In one of two examined on 24th July, 75 per cent. of the foliage and nearly all the flowering shoots had been destroyed ; the damage in the other was less severe. Most of the larvae present at that time were at least half grown. They occurred on the upper surface of the leaves and consumed all the tissues, whereas the few very young larvae found were on the lower surface and did not consume the upper epidermis when feeding. The majority of the adults had only recently emerged.

Plagiodera versicolora, Laich., was first taken in Canada in 1942 [*R.A.E.*, A **33** 71]. In 1944, it was found near Brockville, Ontario, and at additional localities in the Niagara district, but not during an extensive survey along the north-eastern shore of Lake Erie. In 1945, it was found in Quebec at one place to the east of Montreal and three to the south of it. All the Canadian records were from willow.

Almeida (P. R.). **Eficiência comparativa do arseniato de cálcio e do DDT, no contrôle à broca (*Gasterocercodes brasiliensis* Hambl.) do algodoeiro.** [The comparative Efficiency of Calcium Arsenate and DDT in the Control of the Cotton Borer, *Eutinobothrus brasiliensis*.]—*Rev. Agric.* **21** no. 5–6 pp. 183–188, 3 refs. São Paulo, 1946.

An account is given of field-plot tests carried out in the State of São Paulo to compare the efficiency of Gesarol M (which contains 10 per cent. DDT) in sprays, for the control of *Eutinobothrus* (*Gasterocercodes*) *brasiliensis*, Hambleton, on cotton, with that of calcium arsenate [*cf. R.A.E.*, A **29** 624]. The insecticides were applied at 0·5 per cent. with the addition of tar soap as an adhesive, and ten applications were made at intervals of 7–10 days beginning when the plants were 20 days old ; the first three applications were to the whole plant and the rest to the region of the collar only. Plants were removed and examined for infestation after the fifth, ninth and last spray applications. The results showed that Gesarol M was ineffective (11·2, 64·1 and 74·5 per cent. of the plants being infested at the three examinations), whereas calcium arsenate gave significant control (6·5, 33·3 and 55·3 per cent. infested) as compared with no treatment (20, 65·1 and 73·7 per cent.). The progressive increase in infestation is partly attributed to the decreasing number of plants available as a result of thinning and removal for examination.

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(179) Wt. P5/8779 3/48 S.E.R. Ltd. Gp. 432